

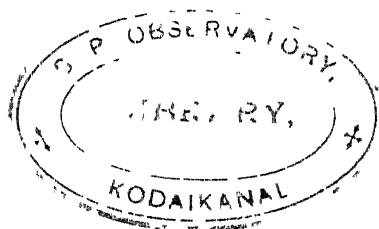


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# AN ATLAS OF ABSORPTION SPECTRA

BY

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LONGMANS, GREEN, AND CO

39, PATERNOSTER ROW, LONDON  
NEW YORK, BOMBAY, AND CALCUTTA

WRATTEN AND WAINWRIGHT, LTD  
CROYDON

1909

IIA Lib.





# AN ATLAS OF ABSORPTION SPECTRA.

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## INTRODUCTION.

One of the branches of our Works being concerned with the manufacture of Colour Filters for all purposes, our laboratory has naturally devoted a considerable amount of attention to the measurement of dye-stuffs, with a view to selecting those suitable for various purposes. Of published records of Absorptions, there are few, and the only atlas of Absorption Spectra, giving Spectra in a convenient form, which is accessible to the student, is the very valuable atlas by Uhler & Wood, published by the Carnegie Institute of Washington. The book by Formánek, useful as it is, can scarcely be termed an "Atlas".

The above-mentioned Atlas was prepared specially with regard to absorptions in the ultra-violet, and to this end the spectra have been photographed with great care, but for the purpose of producing filters for visual work and for photographic work with red-sensitive plates it is necessary to pay special attention to the red, and even the infra-red portions of the spectrum, which are not included in the photographs taken by Uhler & Wood.

Moreover, the dyes used by Uhler & Wood do not include all those in common use, much attention having been paid to the orange and red dyes, while the greens are almost entirely neglected, and the blue dyes have been photographed only to a small extent. For visual work greens are among the most important dye colours.

For these reasons, our laboratory compiled an atlas for themselves, specially adapted for the purpose of selecting dyes for the manufacture of Filters, and when the work was finished it was decided to publish this atlas. We have added to the photographs of dye-stuffs a series of photographs showing the absorptions of some seventy of our own Filters, and we believe that this additional atlas may be of use to those who wish to use filters of a particular kind, and do not want the trouble of preparing their own.

Our best thanks are due to Dr Roques and Dr E Koenig, of the Farbwerke, Hoechst, a/M., both for much direct assistance given, and also for the many valuable new dyes which have been worked out in their laboratories and made available for commerce. Dr Koenig also read the proofs and revised the list of dyes, supplying much valuable information, including the column giving the Stability to Light.

RESEARCH LABORATORY OF WRATTEN & WAINWRIGHT, LTD

C. E. KENNETH MEES (*Director*)

## MATERIAL.

Most of the dye samples which have been photographed were obtained from the Hoechst Farbwerke, and these are generally pure substances. Those samples which were not chemically pure are indicated in the list by an asterisk. This indication is only to be taken as meaning that the sample used was not specially purified from inorganic salts, it does not mean that the dye cannot be obtained in a pure state. Many of the dyes can be obtained from any dye works, and the origin of some of ours is not known. Where possible, we have shown from where they were obtained. All the dyes were measured in water solution. The Filters represent those which we have in stock. These filters are prepared by coating gelatine solutions of the dye, and after drying, stripping the film from glass. They are standardised by comparison with a standard which is kept, and of which the absorption curve has been measured on a spectro-photometer, a comparison being performed by the aid of a crossing filter which allows only a small portion of the spectrum to be passed, when placed over the portion of the filter to be examined. The tricolour Green filter B, for instance, is tested by means of the tricolour Blue and tricolour Red filters. The test consists of a piece of standard Red and a piece of standard Blue side by side, with the standard piece of Green covering half of each of them. The sheet to be tested is placed so as to cover the other half of each film, and a small deviation from standard can be easily perceived on looking through at a diffused light source. The filters are put on the market as film, and also as prepared filters cemented in glass. They are used for orthochromatic and tricolour photography, photo-micrography, spectroscopy, etc.

Probably this complete list of the standard varieties which we keep will be of considerable use to our readers. We have, of course, a number of variants of these standards, and also some special filters for which the use is limited, and which we have not given here.

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## APPARATUS.

The spectroscope used was a small box-form spectroscope with a prism grating. The slit was used at a width of about  $1/3$  m/m, and a scale was fastened in front of the plate with a yellow film arranged to cut out the ultra-violet of the second order, where it overlapped in the red. The scale was adjusted so that approximate wave-lengths could be read direct on the photographs. The apparatus was arranged with a Nernst lamp, focussed by means of a condenser upon the horizontal slit, in front of the slit was held a wedge cell containing the dye solution to be photographed (Fig 1). This wedge cell was a rectangular cell of 1 c/m internal length, and 5 m/m internal width, with a diagonal partition which divided it into two wedge-shaped cells. One of these was filled with the dye solution to be photographed, the other contained plain water. In this way the absorption of the dye varied from end to end of the slit, from a very slight thickness of dye to a very considerable thickness, the actual ratio of thickness from end to end of the slit being about 1 to 15.

The photographs of dye spectra therefore show graphically the variation in the absorption with growing thickness of dye, or what is nearly the same thing, with growing concentration.

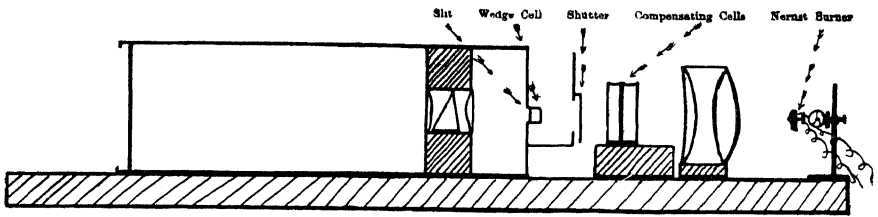


Fig 1 Arrangement of Spectroscope

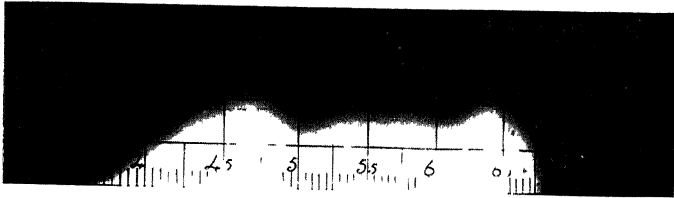


Fig 2 Wedge Spectrum of Wratten Spectrum Panchromatic Plate

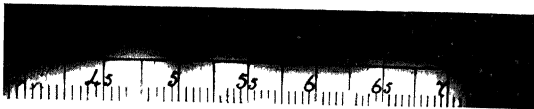


Fig 3 Black Wedge Spectrum of Screened Plate

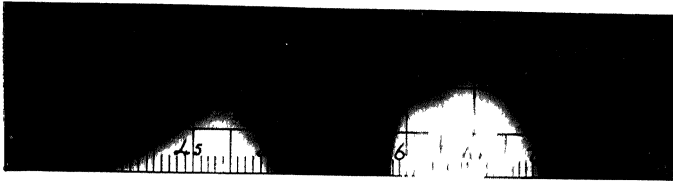


Fig 4 Black Wedge

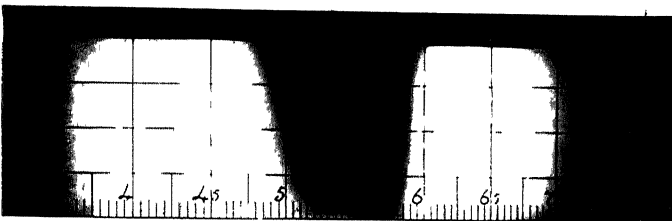


Fig 4 Dye Wedge



## THE PLATE AND THE COMPENSATING FILTERS.

We were very desirous in this investigation to use as extended a spectrum as possible, and we particularly required to photograph far into the deep Red and Infra Red. For this reason we used the plate which we manufacture for use in the photography of the extreme and Infra red, and which we term the "Spectrum Panchromatic" plate. This plate, beside the usual maximum in the violet, has a very strong maximum at 6,500 in the Red, and then falls off towards the Infra Red. With long exposures, its sensitiveness extends to 8,000. It will be seen, however, from Fig 2, which shows its curve to the Nernst lamp, that its distribution of sensitiveness throughout the spectrum is unequal. This was compensated by the introduction of a special screen and two cells containing solutions of Mandarin Orange and P-nitrosodimethylaniline. By this means, a very even spectrum indeed was obtained, extending from about 7,200 to 3,900, and falling off on the one side gradually to 7,500, and on the other 3,500 (Fig 3).

Two groups of dyes, however, were photographed with other arrangements. The dyes which absorb mainly in the Infra Red, beside being photographed for the whole spectrum, were photographed especially for the Red and Infra Red, a Red screen being used, the Spectrum Panchromatic plate and another special filter enabling us to get records extending to 8,000. The Yellows, on the other hand, were photographed on a plate not sensitive to Red, and with stronger solutions of Mandarin Orange and P-nitrosodimethylaniline, enabling us to get even records to 3,500.

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## THE SPECTRUM PHOTOGRAPHS OF FILTERS.

With the filters, we were of course unable to use the wedge cell, and in order to get a graphic representation of the variation of their absorption with wave-length, we used the Spectrum Panchromatic plate, adjusted, as before, and fitted a black wedge made of neutral black glass in front of the slit, in the place of the wedge cell. This black glass gives a range of intensity from end to end of the slit of from 1 to 10,000, and the practically useful portion of the gradation has a range of about 1 to 400. On putting a filter in front of this, we get a graphic representation of the intensity of the light coming through, the interpretation of which is to some extent complicated by the fact that it is affected by the sensitiveness curve of the plate. It seems, however, to be the most satisfactory method of automatically representing the curve of a filter.

Fig 4 shows for comparison purposes the absorption spectrum of a dye wedge of Xylene Red, and the absorption of a cell of the same solution measured by means of a black wedge. It will be seen that while the latter result is not so satisfactory as the dye wedge, it does give a very good idea as to the variation of the transmission of the light in the spectrum.



# INDEX OF DYES.

No	Page	Name of Dye	Strength	Source of Dye.	Acid or Basic	Stability to Light (1 represents highest stability, 5 lowest)
1	13	$\beta$ -Naphtholdisulphonic Acid R	1/2,500	H (Hoechst)	A	
2	13	$\beta$ -Naphtholdisulphonic Acid R	1/100	H	A	
3	13	Æsculine	1/1,000	Merck		
4	13	Picric Acid	1/100		A	
5	14	Filter Yellow K.	1/1,000	H	A	2
6	14	Martius Yellow	1/2,500	*	A	
7	14	Aurophenine Ammonia Salt (Chrysophenine)	1/1,000	H	A	1-2
8	14	Naphthol Yellow	1/1,000	Badische *	A	4-5
9	15	Beizengelb O 5G	1/1,000	H	A	
10	15	Pinatype Yellow F	1/5,000	H	A	2-3
11	15	Thiazole Yellow	1/2,500	Bayer *	A	
12	15	Auramine	1/10,000	H	B	3
13	16	<i>p</i> -nitrosodimethylaniline	1/2,000	H	B	
14	16	Tartrazine	1/5,000	Bayer *	A	2-3
15	16	Pinatype Gold Yellow	1/5,000	H	A	3-4
16	16	Mandarine Orange	1/10,000	Agfa *	A	
17	17	<i>p</i> -toluchinolnchloraceticester dyestuff	1/1,000	H		5
18	17	Flavophosphine	1/10,000	H	B	
19	17	Acridine Orange	1/5,000	Leonhardt, Mulheim	B	2-3
20	17	Auracine G	1/5,000	Bayer *	A	
21	18	Uranine	1/5,000	H *	A	3
22	18	Chrysoidine	1/10,000	H	B	
23	18	Chrysoidine	1/1,000	H	B	4
24	18	Pinatype Purple	1/1,500	H (Mixture)	A	2
25	19	Pinatype Red	1/1,500	H	A	1
26	19	Fast Red	1/1,000	H	A	3-4
27	19	Rapid Filter Red	1/2,000	H	A	2
28	19	Rapid Filter Red	1/1,000	H	A	2
29	20	Rapid Filter Red	1/200	H	A	
30	20	Complementary Scarlet	1/1,500	H	A	
31	20	Complementary Scarlet	1/1,000	H	A	
32	20	Complementary Scarlet	1/800	H	A	

No	Page.	Name of Dye	Strength	Source of Dye	Acid or Basic	Stability to Light
33	21	Complementary Red I .	1/2,000	H	A	
34	21	Complementary Red I .	1/1,000	H	A	
35	21	Complementary Red D .	1/1,500	H	A	3-4
36	21	Brilliant Carmine C	1/2,000	Badische	A	
37	22	Crystal Ponceau .	1/1,000	H	A	3
38	22	Crystal Ponceau	1/500	H	A	
39	22	Brilliant Croceine	1/2,000	H	A	
40	22	Coccine	1/1,000	H	A	2
41	23	Alizarine Red	1/2,000	H	A	2-3
42	23	Congo Red	1/2,000	*	A	
43	23	Congo Red	1/1,000	*	A	3-4
44	23	Iodobenzoin 92	1/200	H	A	Not on market
45	24	Azine Scarlet .	1/500	H	A	
46	24	Fluoresceinate of Sodium (Uranine, pure)	1/1,000	H	A	4-5
47	24	Monobromofluoresceinate of Sodium	1/1,000	H	A	4 5
48	24	Dibromofluoresceinate of Sodium ..	1/1,000	H	A	
49	25	Eosin Yellow Bayer	1/1,000	Bayer *	A	
50	25	Eosin Blue	1/1,000		A	
51	25	Tetrabromofluoresceinate of Sodium (Eosin, pure)	1/1,000	H	A	5
52	25	Diiodofluoresceinate of Sodium	1/1,000	H	A	
53	26	Tetraiodofluoresceinate of Sodium (Erythrosin, pure)	1/1,000	H	A	5
54	26	Scarlet B B extra N	1/1,000	H	A	
55	26	Scarlet B B extra B	1/2,000	H	A	
56	26	Scarlet B B extra B	1/1,000	H	A	
57	27	Tetraiododichlorofluoresceinate of Sodium (Rose Bengal)	1/1,500	H	A	5
58	27	Rose Bengal .	1/1,000	H	A	5
59	27	Rose Bengal 5 B	1/4,000	H	A	5
60	27	Rose Bengal 5 B	1/400	H	A	5
61	28	Cyanosine	1/1,000	H	A	5
62	28	Phloxine B.A Extra	1/1,000	H	A	5
63	28	Phloxine 194 .	1/1,000	H	A	5

No	Page	Name of Dye	Strength	Source of Dye	Acid or Basic	Stability to Light
64	28	Phloxine A	1/3,000	H	A	5
65	29	Phloxine Rhodamine	1/1,000	H	B	5
66	29	Rhodamine 6 G	1/1,000	H	B	3-4
67	29	Tetramethyl Rhodamine	1/2,000	H	B	3-4
68	29	Acid Rhodamine 3 R	1/1,000	H	A	
69	30	Rhodamine B	1/1,000	Bayer *	B	3-4
70	30	Phenosafranine	1/2,000	H	B	
71	30	Xylene Red B	1/2,500	H	A & B	
72	30	Amidonaphthol Red 6 B	1/2,500	H	A	2-3
73	31	Safranin G	1/2,500	H	A	3
74	31	Safranin R	1/2,500	H	A	3
75	31	Pinatype Amaranth	1/1,000	H	A	3-4
76	31	Pinatype Violet	1/2,000	H	A	3-4
77	32	Pinatype Carmine	1/2,000	H	A	
78	32	Pinatype Carmine	1/500	H	A	
79	32	Rapid Filter Blue	1/5,000	H	A	2-3
80	32	Rapid Filter Blue	1/1,000	H	A	2-3
81	33	Rosinduline 2 B Bluish	1/2,500	H	A	
82	33	Acid Violet 4 R	1/2,500	Badische *	A	2-3
83	33	Acid Violet 4 R	1/2,000	Badische *	A	2-3
84	33	Chromotrope F 4B	1/2,000	H *	A	
85	34	Chromotrope 10 B	1/2,500	H *	A	
86	34	Acid Chrome Blue 2 R	1/2,500	H	A	
87	34	Acid Chrome Blue	1/2,500	H *	A	
88	34	Echt Beizenblau	1/2,000	H *	A	
89	35	Fuchsine	1/2,500	Bayer *	B	4-5
90	35	Rubin Fuchsine	1/2,500	H	B	4-5
91	35	Methyl Violet B B R	1/2,500	H	B	5
92	35	Methyl Violet 6 B	1/2,500	*	B	5
93	36	Methyl Violet 1 B	1/16,000	Bayer *	B	5
94	36	Crystal Violet	1/10,000	H	B	
95	36	Crystal Violet	1/5,000	H	B	
96	36	Gentian Violet	1/2,000	Bayer *	B	
97	37	Acid Violet B N.	1/300	H *	A	4-5
98	37	Acid Violet 4 B C	1/2,500	Badische *	A	4-5
99	37	Acid Violet 4 B C	1/500	Badische *	A	4-5
100	37	Rhoduline Blue R	1/2,500	H	B	4-5
101	38	Aniline Blue	1/2,500	H *	B	3
102	38	Alkali Blue	1/5,000	H *	A	3
103	38	Alkali Blue	1/1,000	H *	A	3
104	38	Victoria Pure Blue B	1/10,000	Badische *	B	

No	Page	Name of Dye	Strength	Source of Dye	Acid or Basic	Stability to Light
105	39	Victoria Pure Blue B	1/2,000	Badische *	B	
106	39	Victoria Blue B	1/10,000	Badische *	B	4-5
107	39	Victoria Blue B .	1/2,500	Badische *	B	4-5
108	39	Victoria Blue B S	1/10,000	Badische *	B	4-5
109	40	Victoria Blue B S S	1/10,000	Badische *	B	4-5
110	40	Victoria Blue 4 R	1/10,000	Badische *	B	4-5
111	40	Victoria Blue 4 R	1/5,000	Badische *	B	4-5
112	40	Victoria Blue R	1/10,000	Badische *	B	4-5
113	41	Victoria Blue R	1/5,000	Badische *	B	4-5
114	41	Night Blue	1/5,000	Badische *	B	
115	41	Night Blue	1/2,000	Badische *	B	
116	41	Pinatype Blue	1/5,000	H	A	3
117	42	Toluidine Blue	1/5,000	H	A	1
118	42	Toluidine Blue (red end only)	1/10,000	H	A	
119	42	Toluidine Blue (red end only)	1/1,000	H	A	
120	42	Methylene Blue	1/10,000	H	B	2-3
121	43	Methylene Blue	1/5,000	H	B	2-3
122	43	Methylene Blue (red end only)	1/5,000	H	B	2-3
123	43	Thionine Blue	1/10,000	H	B	
124	43	Janus Green	1/1,000	H *	B	4-5
125	44	Patent Blue A	1/10,000	H	A	3
126	44	Patent Blue A.	1/2,500	H	A	3
127	44	Patent Blue V	1/10,000	H	A	3
128	44	Patent Blue V	1/5,000	H	A	3
129	45	Patent Blue V	1/1,000	H	A	3
130	45	Cyanine Blue	1/10,000	H	A	3
131	45	Erioglaucine A	1/10,000	Geigy *	A	3
132	45	Erioglaucine A	1/1,000	Geigy *	A	3
133	46	Setoglaucine	1/5,000	Geigy *	B	
134	46	Turkish Blue B B	1/10,000	Bayer *	A	
135	46	Turkish Blue B B	1/1,000	Bayer *	A	
136	46	Methylene Green	1/5,000	H *	B	2
137	47	Methylene Green	1/1,000	H *	B	2
138	47	Iodine Green	1/10,000	H *	B	5
139	47	Iodine Green	1/1,000	H *	B	5
140	47	Fast Green Blue Shade	1/1,000	Bayer *	A	
141	48	Complementary Green 1	1/10,000	H	A	4
142	48	Complementary Green 1	1/1,000	H	A	4
143	48	Solid Green	1/1,000	Bayer	A	

No	Page	Name of Dye	Strength	Source of Dye	Acid or Basic	Stability to Light
144	48	NewSolidGreen 3 B	1/10,000	H	A	
145	49	NewSolidGreen 3 B	1/1,000	H	A	
146	49	Naphthaline Green	1/10,000	H	A	3-4
147	49	Naphthaline Green	1/1,000	H	A	3-4
148	49	Rapid Filter Green	1/10,000	H	A	3
149	50	Rapid Filter Green	1/1,000	H	A	3
150	50	Acid Green	1/5,000	H *	A	4
151	50	Acid Green	1/1,000	H *	A	4
152	50	Emerald Green	1/1,000	Bayer *	B	
153	51	Brilliant Green	1/5,000	*	B	4
154	51	Diamond Green	1/10,000	Badische *	B	
155	51	Diamond Green	1/1,000	Badische *	B	
156	51	Victoria Green 1	1/10,000	Bayer *	B	
157	52	Victoria Green 1	1/1,000	Bayer *	B	
158	52	Eboli Green	1/1,000	Leonhardt *	A	
159	52	Naphthol Green (red end only) ..	1/5,000	H	A	1-2
160	52	Naphthol Green (red end only)	1/1,000	H	A	1-2
161	53	Naphthol Green	1/1,000	H	A	1-2
162	53	Naphthol Green 2 6 (red end only)	1/2,500	H	A	
163	53	Naphthol Green 2 6	1/1,000	H	A	
164	53	Pinatype Green M (red end only)	1/5,000	H	A	1
165	54	Pinatype Green M	1/1,000	H	A	1
166	54	Toluidine Green (red end only)	1/2,000	H	A	1
167	54	Filter Blue Green	1/1,000	H	A	3-4
168	54	Filter Blue Green (red end only)	1/500	H	A	3-4
169	55	Filter Blue Green (red end only)	1/200	H	A	3-4
170	55	Filter Blue Green (red end only) ..	1/100	H	A	3-4

# INDEX OF FILTERS.

No	Page	Name of Filter	No	Page	Name of Filter
1	56	$\beta$ -Naphtholdisulphonic Acid	40	65	Blue 316
2	56	Æsculine	41	66	Blue 363
3	56	Picric Acid "D"	42	66	Blue 445
4	56	Picric Acid "C"	43	66	Minus Red 2
5	57	Picric Acid "B"	44	66	Minus Red 4 <b>Standard Complementary</b>
6	57	Picric Acid "A"	45	67	H <b>M.</b>
7	57	K1	46	67	$\eta$ Blue
8	57	K2	47	67	C (light)
9	58	K3 <b>M.</b>	48	67	C1 <b>M. Standard Tricolour</b>
10	58	Tartrazine 1	49	68	C2
11	58	Tartrazine 2	50	68	Mercury Violet <b>Mercury Monochromat</b>
12	58	Minus Blue <b>Standard Complementary</b>			(Contrast "L")
13	59	G A 1	51	68	Naphthol Green 1
14	59	G A 4	52	68	Naphthol Green 2
15	59	G <b>M.</b>	53	69	Naphthol Green 3
16	59	Flavazine T	54	69	Naphthol Green 4
17	60	<i>p</i> -nitrosodimethylaniline	55	69	Stereo Green
18	60	Ultraviolet Filter	56	69	B3
19	60	Mandarine Orange	57	70	B2 (light)
20	60	Monobromofluoresceine (light)	58	70	B2
21	61	Monobromofluoresceine (dark)	59	70	B <b>M. Standard Tricolour Green</b>
22	61	E2 <b>M.</b>	60	70	$\delta$ Green (Contrast "P")
23	61	E1	61	71	Additive Green (Contrast "N")
24	61	E (red)	62	71	Mercury Green <b>Mercury Monochromat</b>
25	62	A <b>M. Standard Tricolour</b>	63	71	$\epsilon$ Green
26	62	Stereo Red	64	71	Minus Red 3 (light)
27	62	F1	65	72	Minus Red 3
28	62	F2	66	72	Rapid Filter Green
29	63	F3 <b>M.</b>	67	72	$\gamma$ Green 2
30	63	Rose Bengal	68	72	$\gamma$ Green 3
31	63	Minus Green 1	69	73	$\gamma$ Green 4
32	63	Minus Green 3 <b>Standard Complementary</b>	70	73	$\alpha$ (Monochromat) (Contrast "R")
33	64	Xylene Red	71	73	$\beta$ (Monochromat)
34	64	D (light)	72	73	$\gamma$ (Monochromat)
35	64	D <b>M.</b>	73	74	$\delta$ (Monochromat)
36	64	Methyl Violet B.B R	74	74	$\epsilon$ (Monochromat)
37	65	$\beta$ Blue	75	74	$\eta$ (Monochromat)
38	65	$\beta$ Blue (dark)	76	74	$\theta$ (Monochromat)
39	65	Blue 203			

## SPECIAL SERIES OF FILTERS INCLUDED IN THE FILTER LIST.

Series	Variety	Number	Page
K (Orthochromatic)	K1	7	57
	K2 . .	8	57
	K3	9	58
Tricolour Standard . . .	Red .	25	62
	Green .	59	70
	Blue	48	67
Complementary Filters . .	Minus Red	44	66
	Minus Green	32	63
	Minus Blue	12	58
M Filters (for Microscopy)	A	25	62
	B	59	70
	C	48	67
	D	35	64
	E	22	61
	F	29	63
	G	15	59
	H	45	67
	K3	9	58
Monochromats	$\alpha$	70	73
	$\beta$	71	73
	$\gamma$	72	73
	$\delta$ .	73	74
	$\epsilon$	74	74
	$\eta$	75	74
	$\theta$	76	74
Mercury Vapour Lamp Mono- chromats	Green	62	71
	Yellow (E 2)	22	61
	Violet	50	68
Contrast Filters not included in "M" set	L (Violet)	50	68
	N (Pure Green)	61	71
	P (Blue Green)	60	70
	R (Deep Red)	70	73

**Dyes.**

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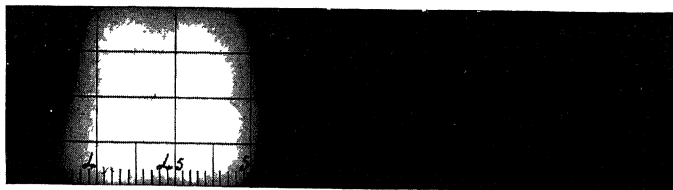


Fig 1  $\beta$  Naphtholdisulphonic Acid R 1/2,500 (Blue end only)

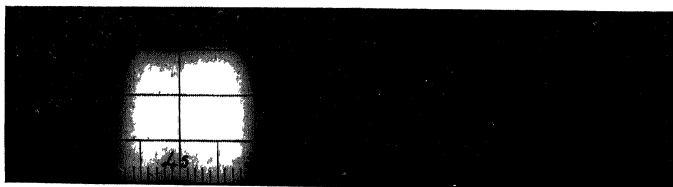


Fig 2  $\beta$  Naphtholdisulphonic Acid R 1/100 (Blue end only)

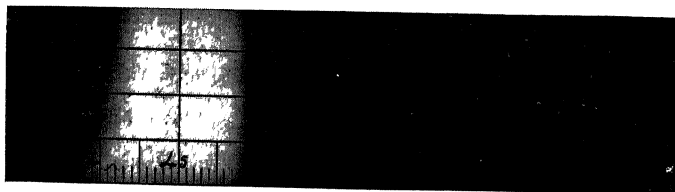


Fig 3 Eosuline 1/1,000 (Blue end only)

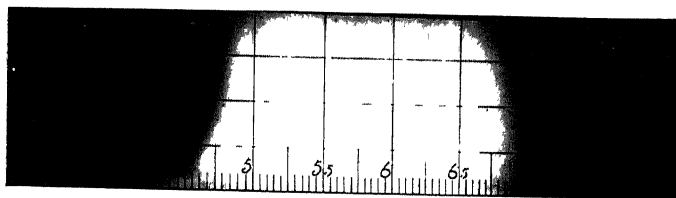


Fig 4 Picric Acid 1/100





Fig 5 Filter Yellow K 1/1,000 (Blue end only)

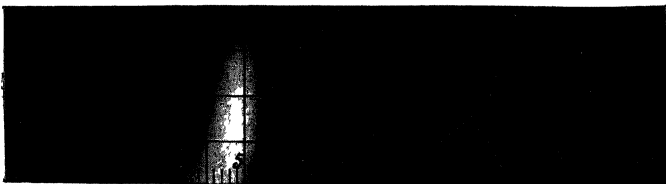


Fig 6 Martius Yellow 1/2,500 (Blue end only)

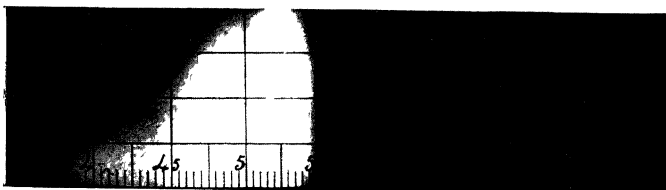


Fig 7 Auropheenne Ammonia Salt 1/1,000 (Blue end only)

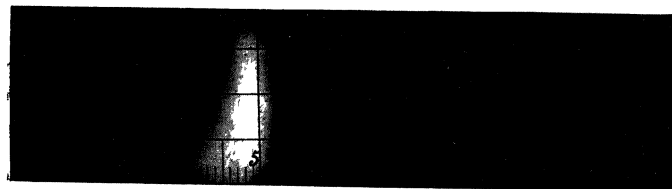


Fig 8 Naphthol Yellow 1/1,000 (Blue end only)

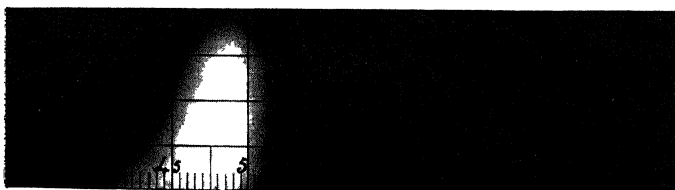


Fig 9 Beizengelb O 5 G 1/1,000 (Blue end only)

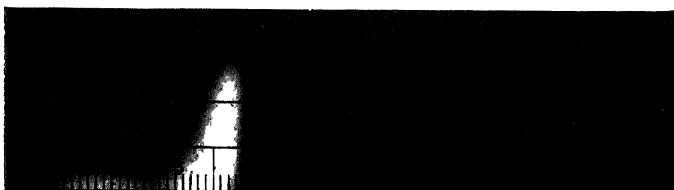


Fig 10 Pinatype Yellow F 1/5,000 (Blue end only)

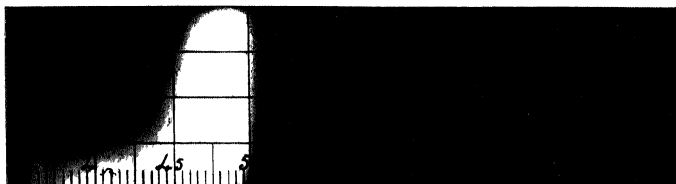


Fig 11 Thiazole Yellow 1/2,500 (Blue end only)



Fig 12 Auramine 1/10,000 (Blue end only)

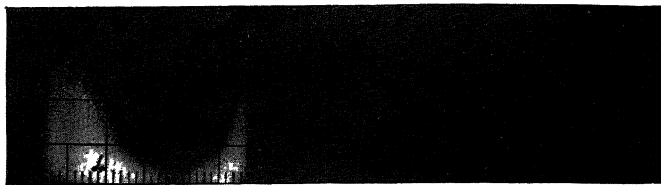


Fig 13 *p* nitrosodimethylaniline 1/2,000 (Blue end only)

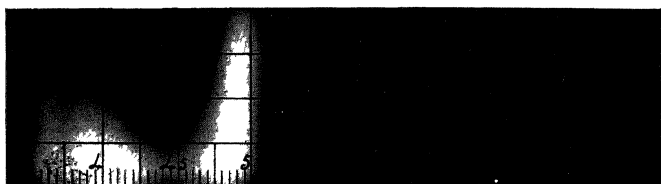


Fig 14 Tutarzine 1/5,000 (Blue end only)



Fig 15 Pinatype Gold Yellow 1/5,000 (Blue end only)

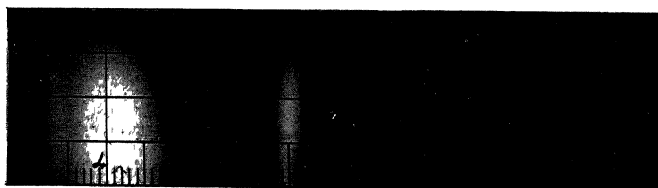


Fig 16 Mandarin Orange 1/10,000 (Blue end only)

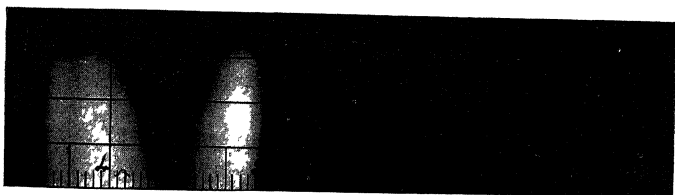


Fig 17  $\rho$  toluchmolinchloraceticesterdye stuff 1/1,000 (Blue end only)

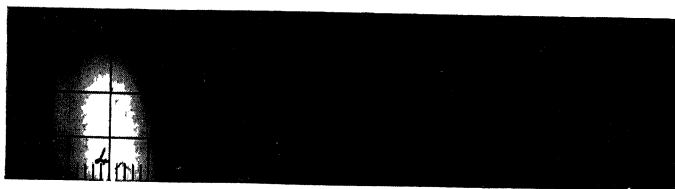


Fig 18 Flavophosphine 1/10,000 (Blue end only)

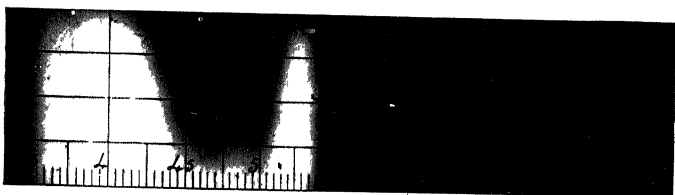


Fig 19 Acidine Orange 1/5,000 (Blue end only)

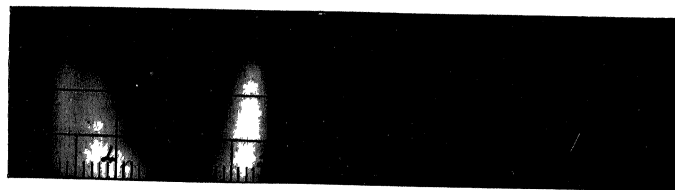


Fig 20 Auramine G 1/5,000 (Blue end only)

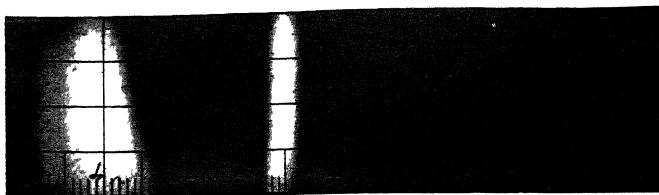


Fig 21 Urmine 1/5,000 (Blue end only)

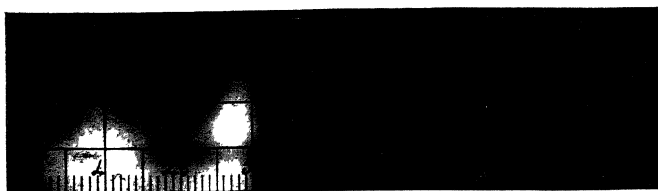


Fig 22 Chrysoidine 1/10,000 (Blue end only)

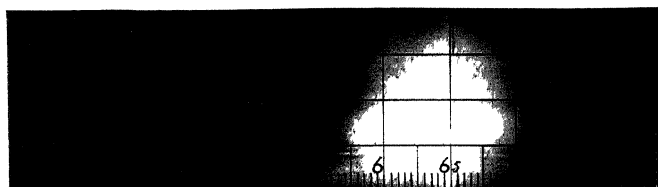


Fig 23 Chrysoidine 1/1,000

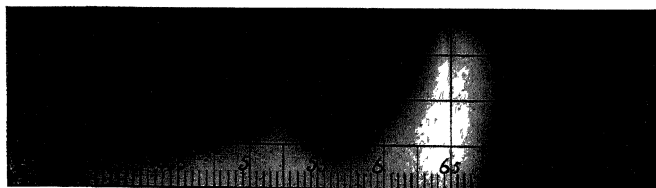


Fig 24 Pinatype Purple 1/1,500

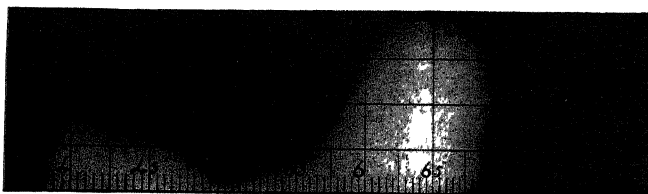


Fig 25 Pinatype Red 1/1,500

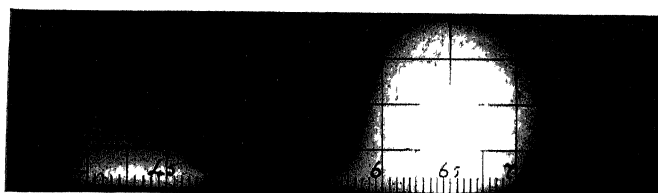


Fig 26 Fast Red 1/1,000

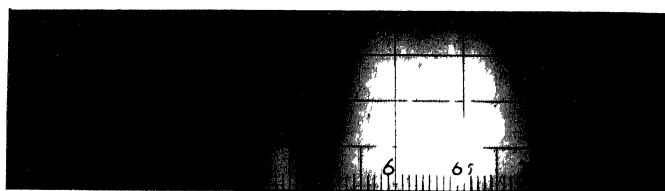


Fig 27 Rapid Filter Red 1/2,000

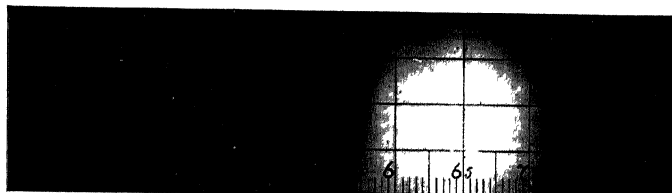


Fig 28 Rapid Filter Red 1/1,000



Fig 29 Rapid Filter Red 1,200

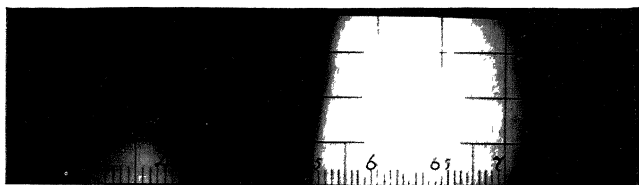


Fig 30 Complementary Scarlet 1/1,500

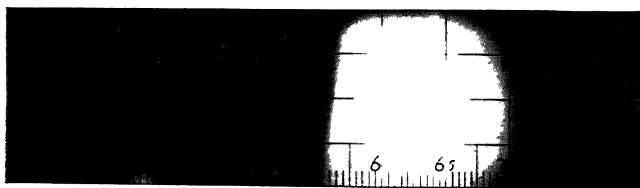


Fig 31 Complementary Scarlet 1/1,000

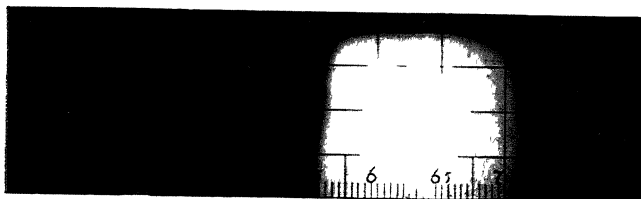


Fig 32 Complementary Scarlet 1/800

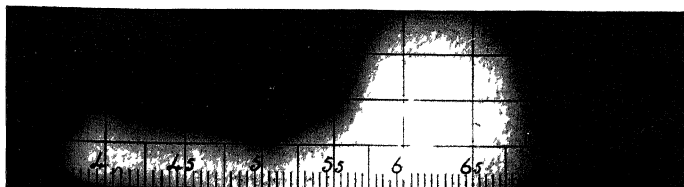


Fig 33 Complementary Red 1  $1/2,000$

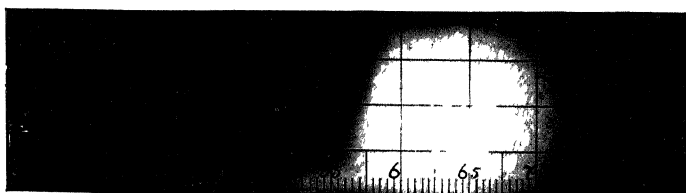


Fig 34 Complementary Red 1  $1/1,000$

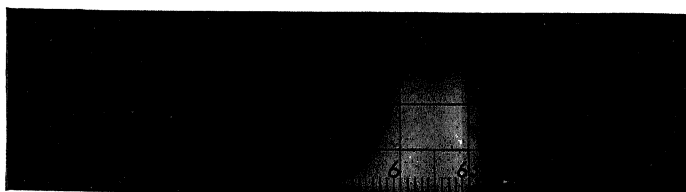


Fig 35 Complementary Red D  $1/1,500$

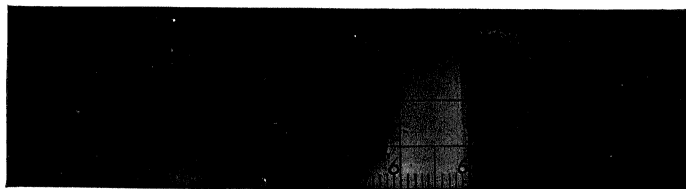


Fig 36 Brilliant Carmine C  $1/2,000$



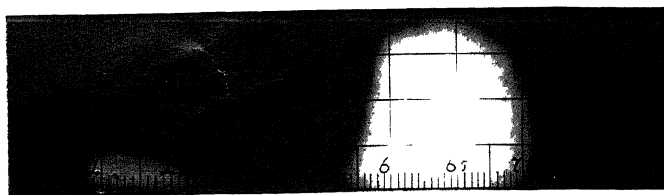


Fig 37 Crystal Ponceau 1/1,000

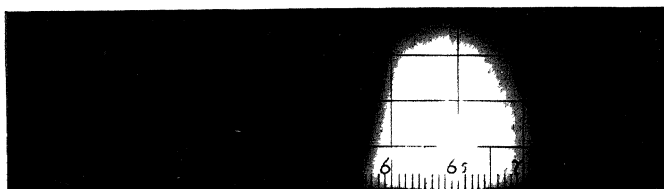


Fig 38 Crystal Ponceau 1/500

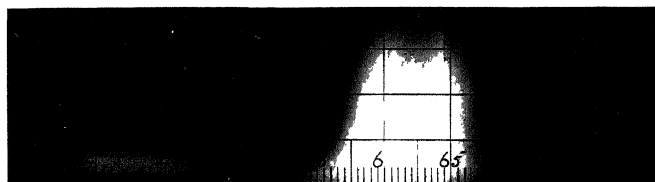


Fig 39 Brilliant Croceine 1/2,000

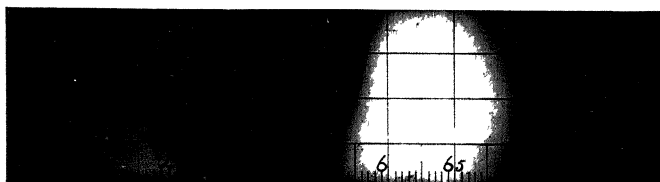


Fig 40 Coccinune 1/1,000

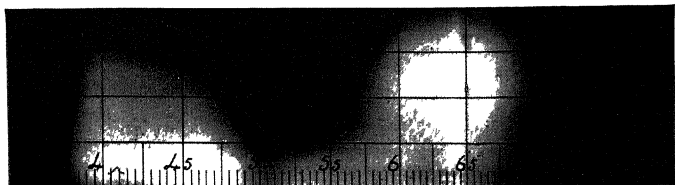


Fig 41 Alizarine Red 1/2,000

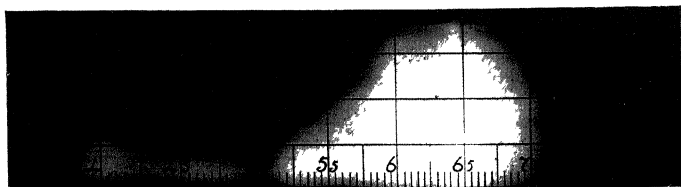


Fig 42 Congo Red 1/2,000

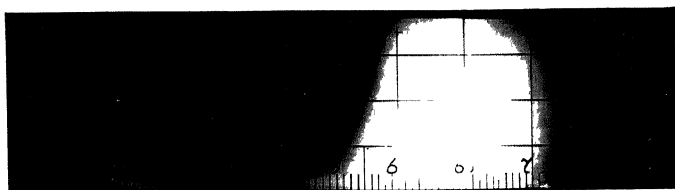


Fig 43 Congo Red 1/1,000

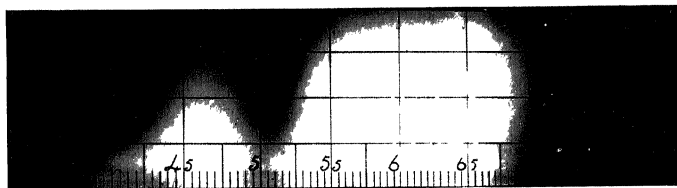


Fig 44 Iodobenzoin 92 1/200

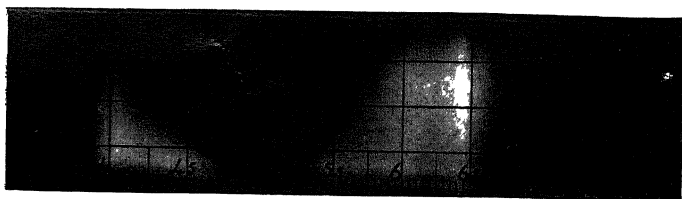


Fig 45 Azine Scarlet 1/500

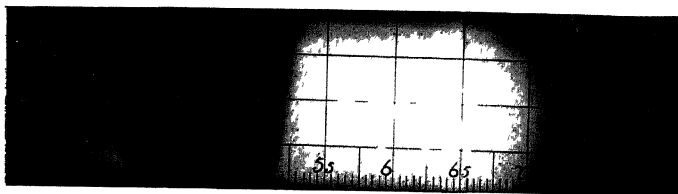


Fig 46 Fluoresceinate of Sodium 1/1,000

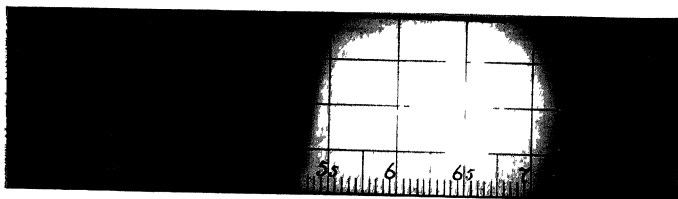


Fig 47 Monobromofluoresceinate of Sodium 1/1,000

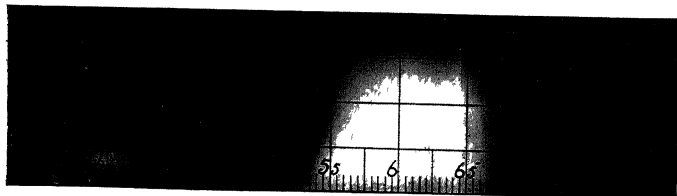


Fig 48 Dibromofluoresceinate of Sodium 1/1,000

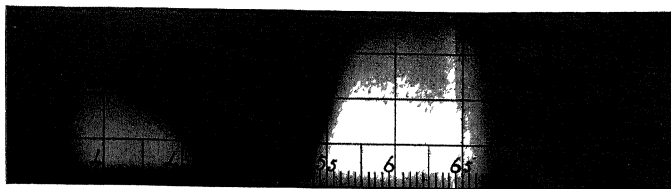


Fig 49 Eosine Yellow Bayer 1/1,000

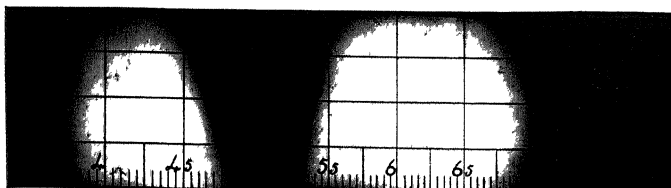


Fig 50 Eosine Blue 1/1,000

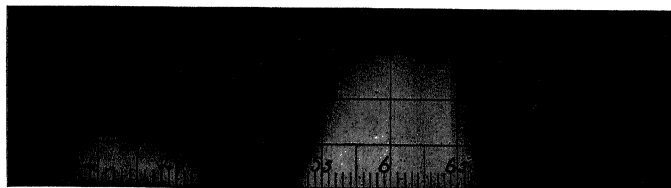


Fig 51 Tetra bromofluoresceinate of Sodium 1/1,000

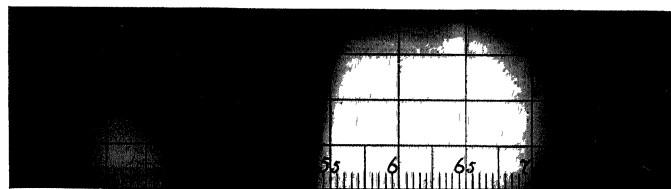


Fig 52 Diiodofluoresceinate of Sodium 1/1,000

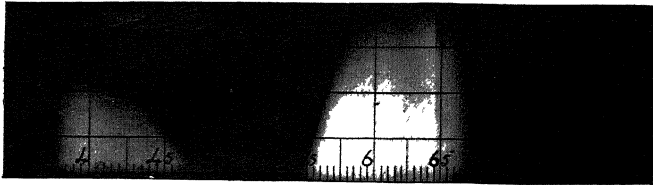


Fig 53 Tetraiodofluoresceinite of Sodium 1/1,000

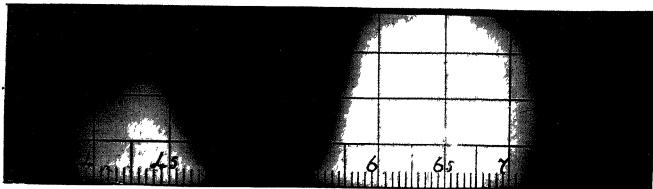


Fig 54 Scarlet B B extra N 1/1,000

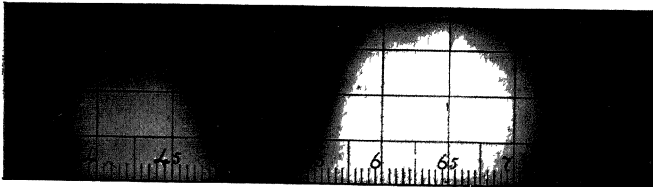


Fig 55 Scarlet B B extra B 1/2,000

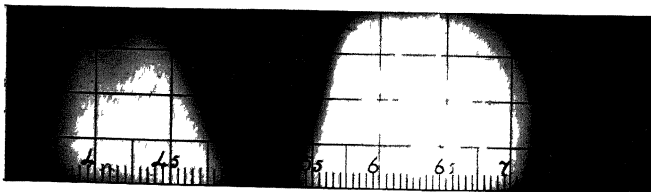


Fig 56 Scarlet B B extra B 1/1,000

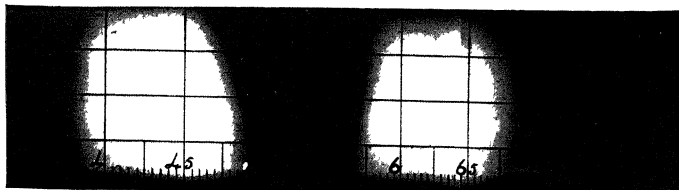


Fig 57 Rose Bengal 1/1,500

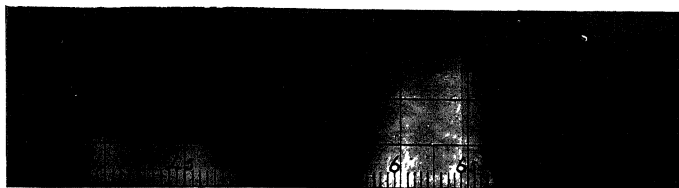


Fig 58 Rose Bengal 1/1,000

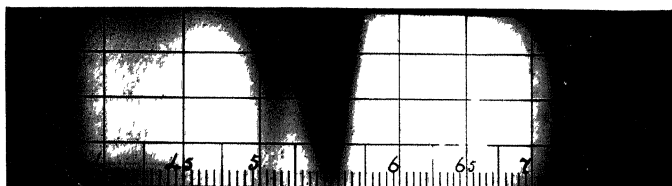


Fig 59 Rose Bengal 5 B 1/4,000

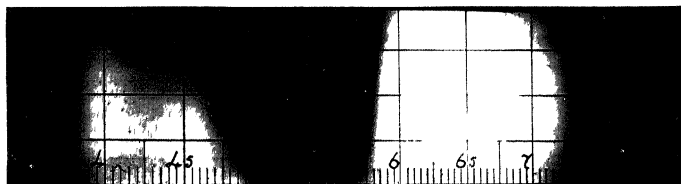


Fig 60 Rose Bengal 5 B 1/400

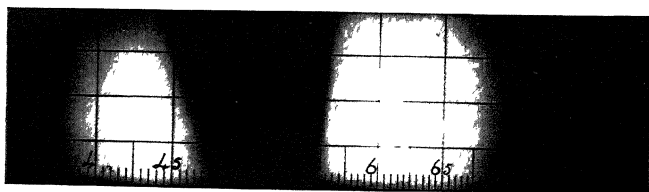


Fig 61 Cytosine 1/1 000

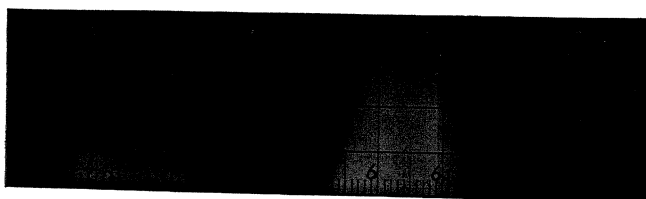


Fig 62 Phloxine B A Extra 1/1,000

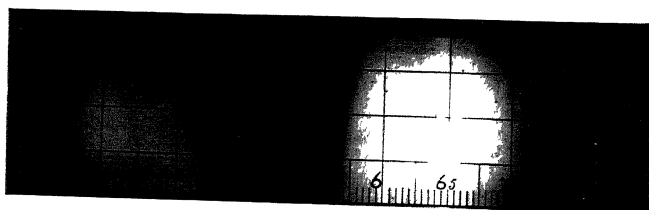


Fig 63 Phloxine 194 1/1,000

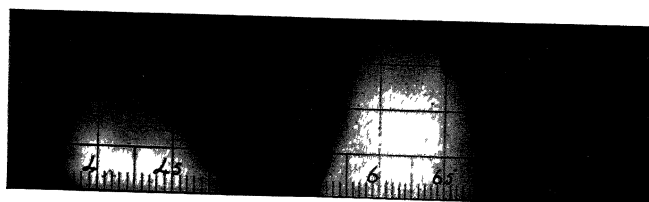


Fig 64 Phloxine A 1/3,000

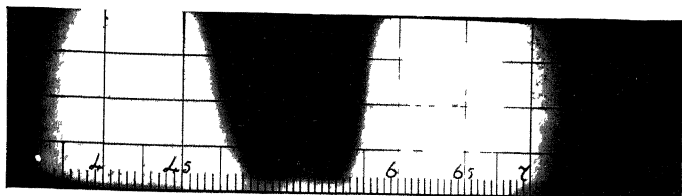


Fig 65 Phloxine Rhodamine 1/1,000

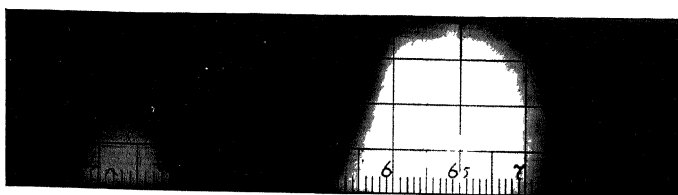


Fig 66 Rhodamine 6 G 1/1,000

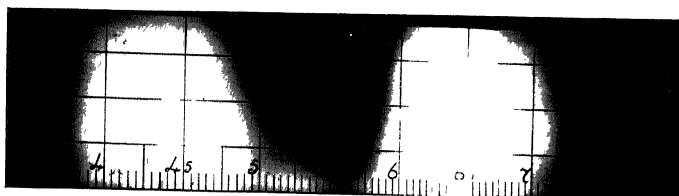


Fig 67 Tetramethyl Rhodamine 1/2,000

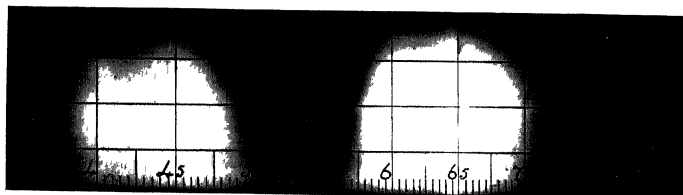


Fig 68 Acid Rhodamine 3 R 1/1,000



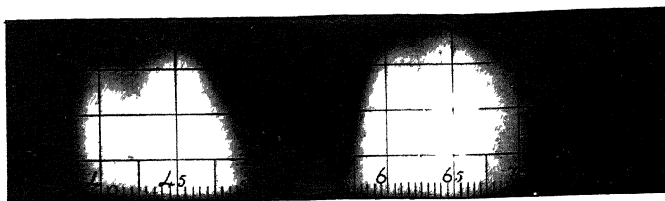


Fig 69 Rhodamine B 1/1,000

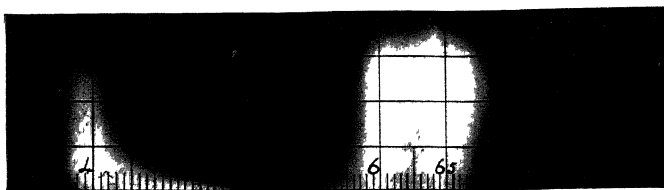


Fig 70 Phenolphthalein 1/2,000

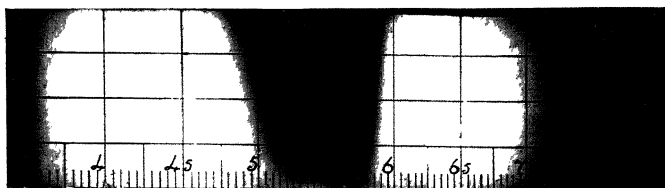


Fig 71 Xylene Red B 1/2,500



Fig 72 Amidonaphthol Red 6 B 1/2,500

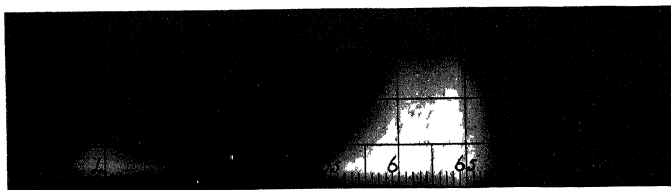


Fig 73 Safranin G 1/2 500

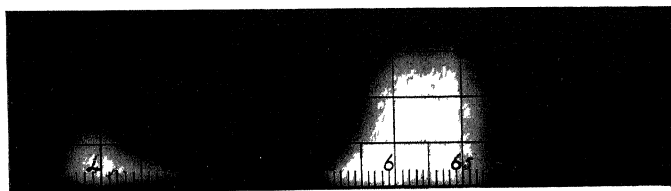


Fig 74 Safranin R 1/2,500

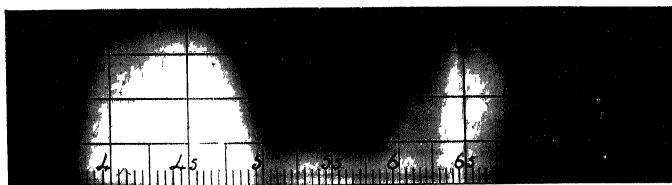


Fig 75 Pmatype Amaranth 1/1,000

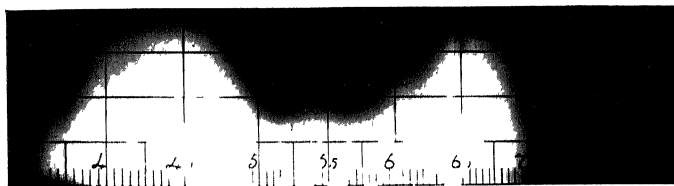


Fig 76 Pmatype Violet 1/2,000

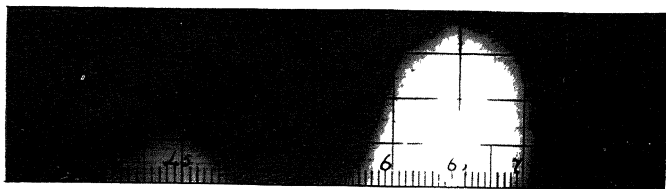


Fig 77 Pinatype Carmine 1/2,000

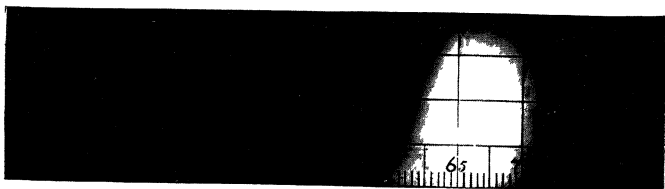


Fig 78 Pinatype Carmine 1/500

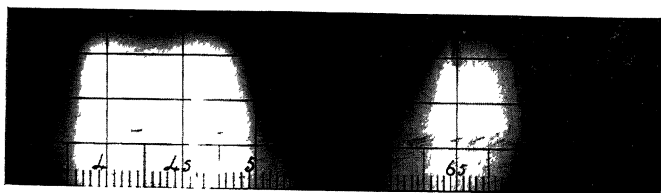


Fig 79 Rapid Filter Blue 1/5,000

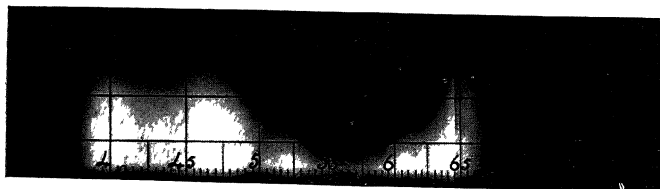


Fig 80 Rapid Filter Blue 1/1,000

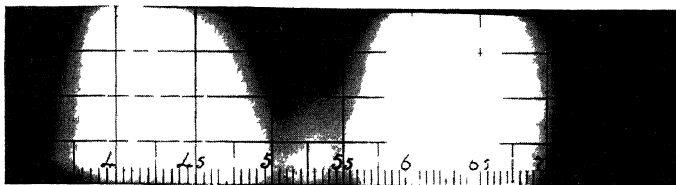


Fig 81 Rosindulme 2 B Bluish 1/2,500

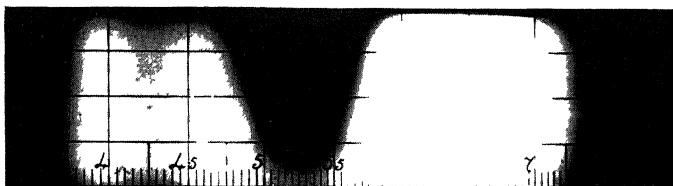


Fig 82 Acid Violet 4 R 1/2,500

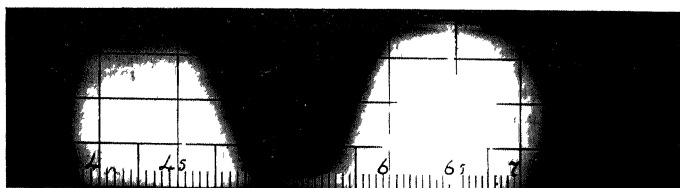


Fig 83 Acid Violet 4 R 1/2,000

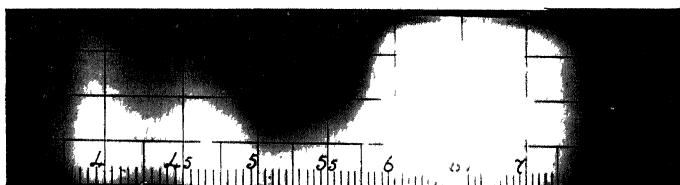


Fig 84 Chromotropic F 4 B 1/2,000

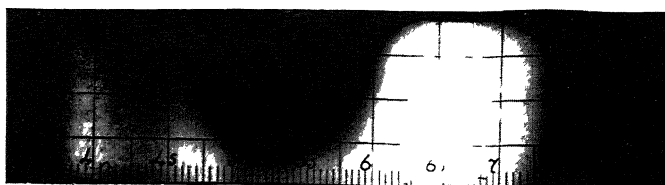


Fig 85 Chromotrope 10 B 1/2,500

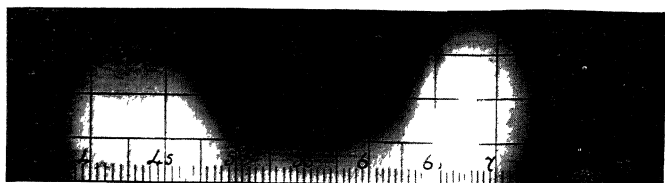


Fig 86 Acid Chrome Blue 2 R 1/2,500

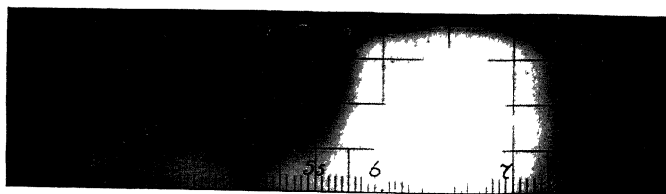


Fig 87 Acid Chrome Blue 1/2,500

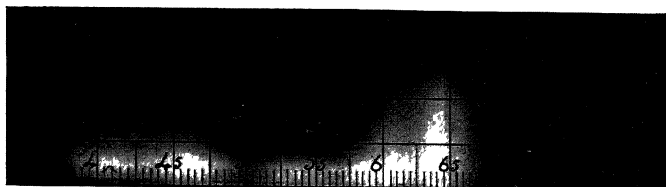


Fig 88 Echt Beizenblau 1/2,000

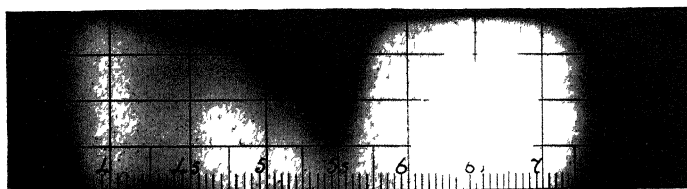


Fig 89 Fuchsin 1/2,500

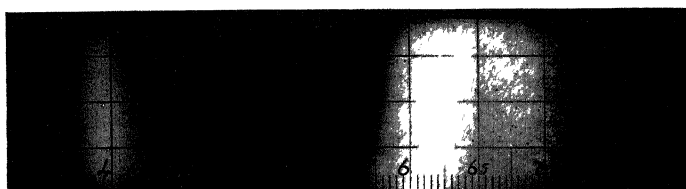


Fig 90 Rubin Fuchsin 1/2,500

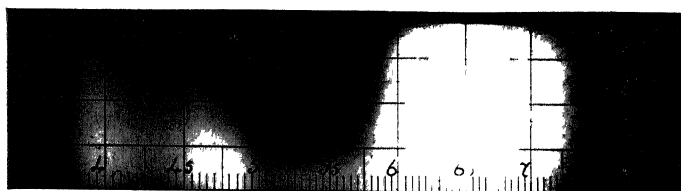


Fig 91 Methyl Violet B B R 1/2,500

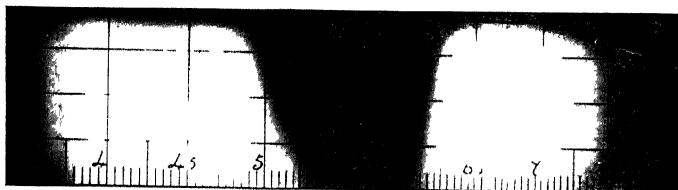


Fig 92 Methyl Violet 6 B 1/2,500



Fig 93 Methyl Violet 1 B 1/16,000

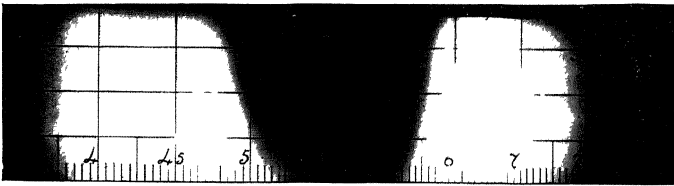


Fig 94 Crystal Violet 1/10,000

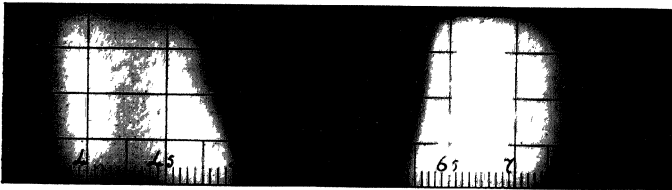


Fig 95 Crystal Violet 1/5,000

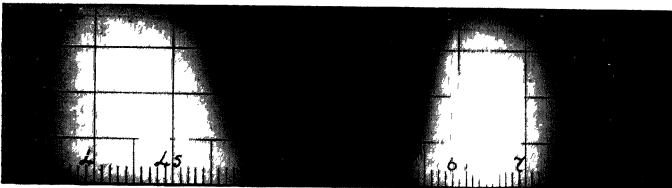


Fig 96 Gentian Violet 1/2 000

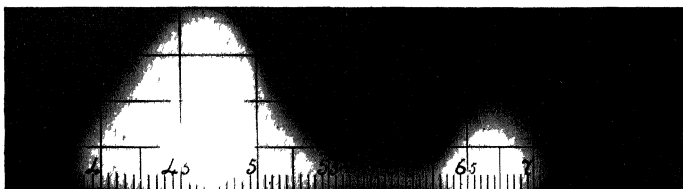


Fig 97 Acid Violet B N 1/300



Fig 98 Acid Violet 4 B C 1/2,500



Fig 99 Acid Violet 4 B C 1/500

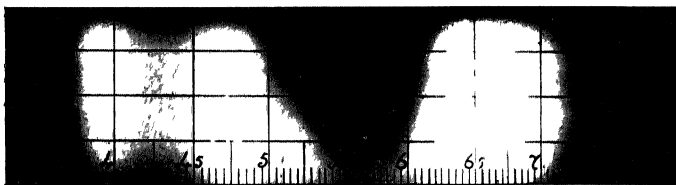


Fig 100 Rhodulme Blue P 1/2,500



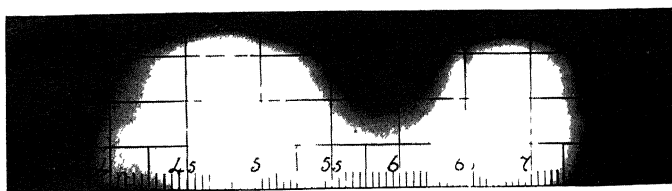


Fig 101 Amiline Blue 1/2,500

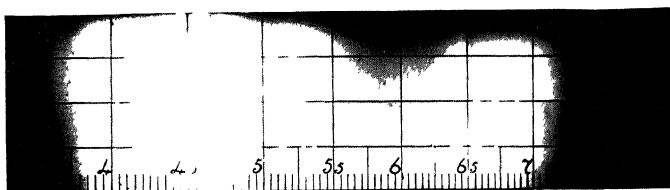


Fig 102 Alkali Blue 1/5000

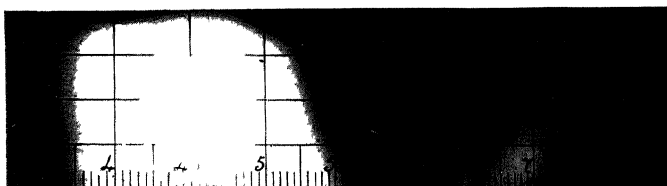


Fig 103 Alkali Blue 1/1,000

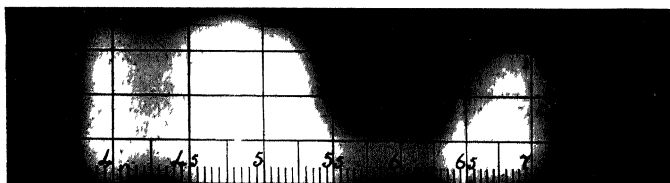


Fig 104 Victoria Pure Blue B 1/10,000

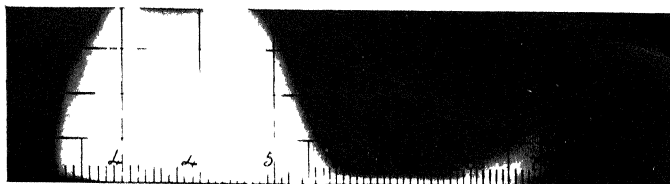


Fig 105 Victoria Pure Blue B 1/2 000

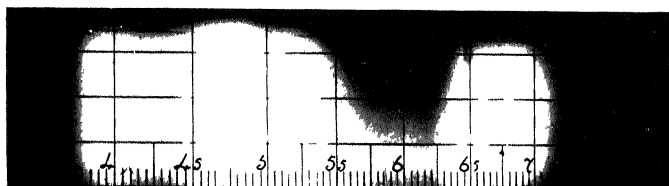


Fig 106 Victoria Blue B 1/10,000

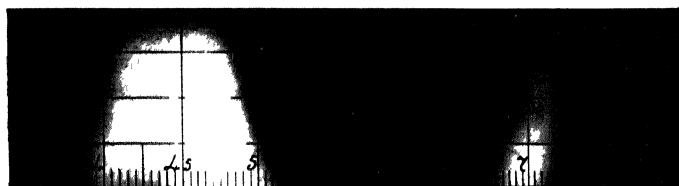


Fig 107 Victoria Blue B 1/2,500

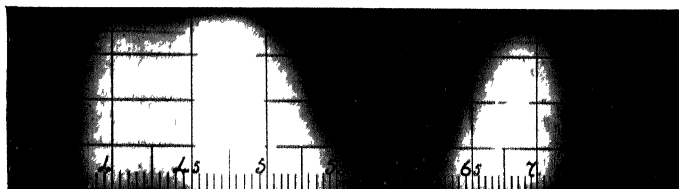


Fig 108 Victoria Blue B S 1/10,000

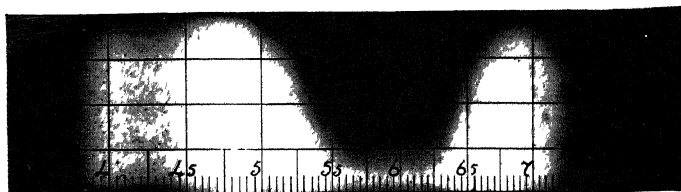


Fig 109 Victoria Blue B S S 1/10,000

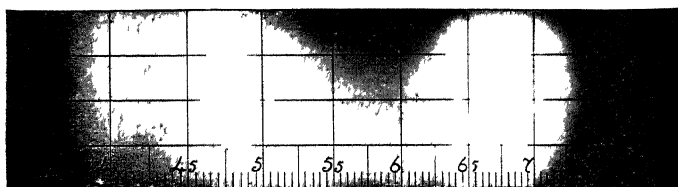


Fig 110 Victoria Blue 4 R 1/10 000

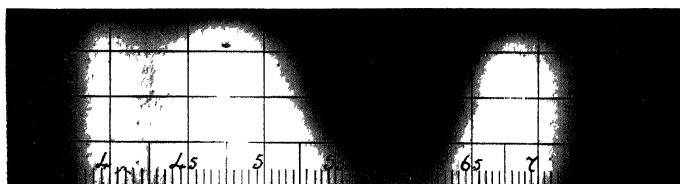


Fig 111 Victoria Blue 4 R 1/5 000,

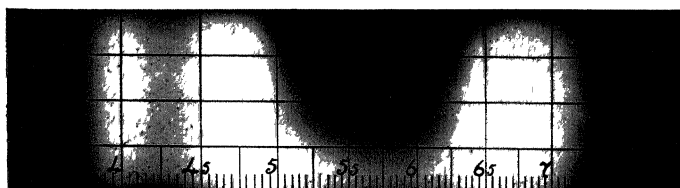


Fig 112 Victoria Blue R 1/10,000

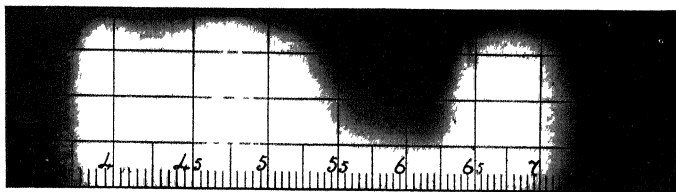


Fig 113 Victoria Blue R 1/5,000

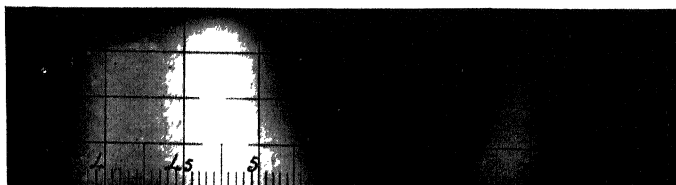


Fig 114 Night Blue 1/5,000

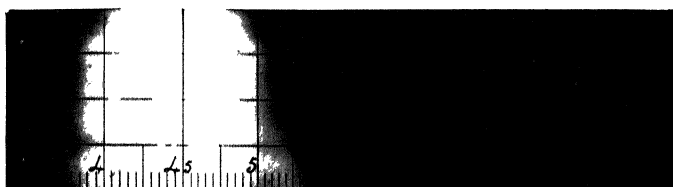


Fig 115 Night Blue 1/2,000

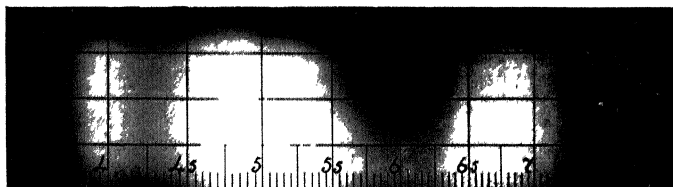


Fig 116 Pinatype Blue 1/5,000

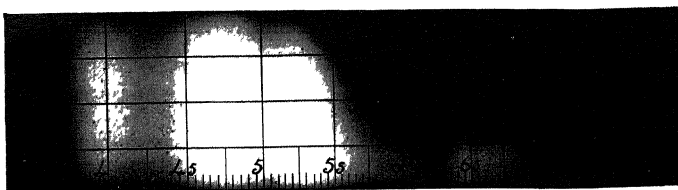


Fig 117 Toluidine Blue 1/5,000

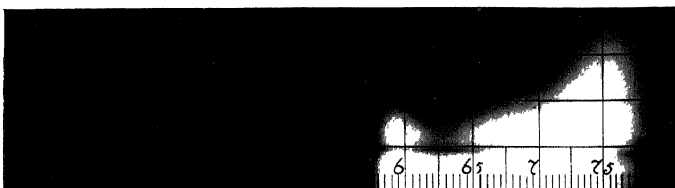


Fig 118 Toluidine Blue 1/10,000 (Red end only)

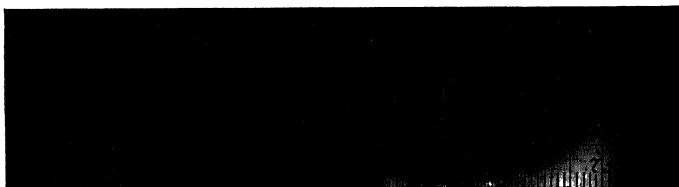


Fig 119 Toluidine Blue 1/1,000 (Red end only)

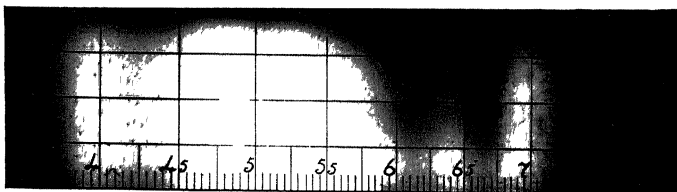


Fig 120 Methylene Blue 1/10,000

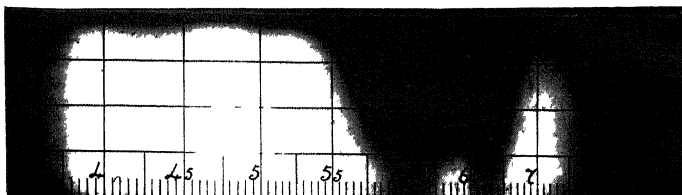


Fig 121 Methylene Blue 1/5,000



Fig 122 Methylene Blue 1/5,000 (Red end only)

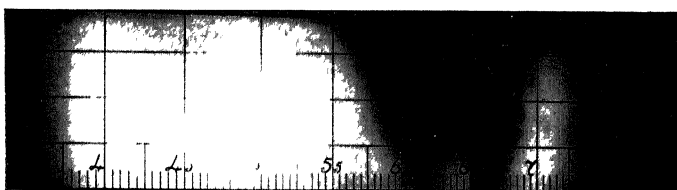


Fig 123 Thionine Blue 1/10,000

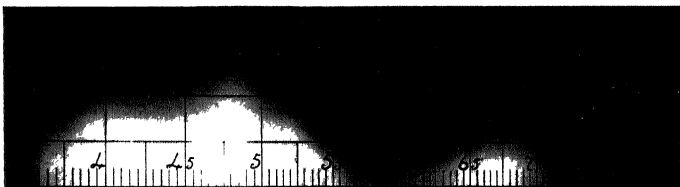


Fig 124 Janus Green 1/1,000

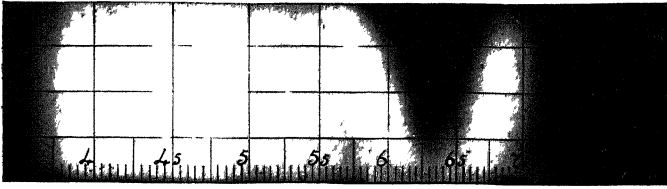


Fig 125 Patent Blue A 1/10 000

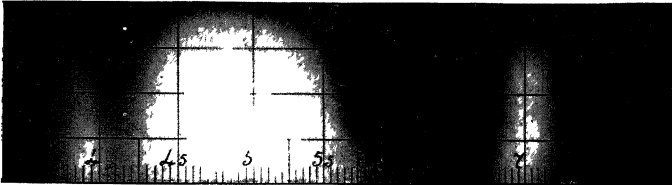


Fig 126 Patent Blue A 1/2,500

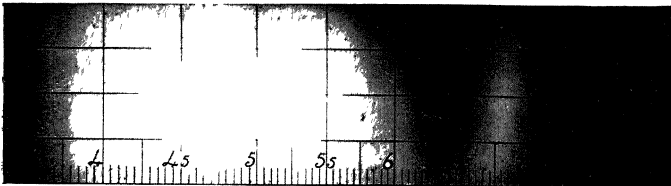


Fig 127 Patent Blue V 1/10,000

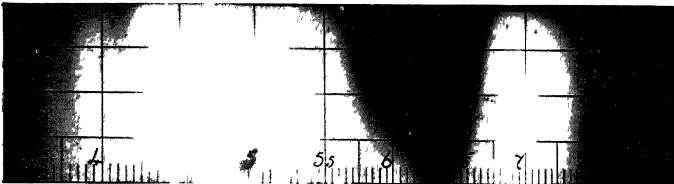


Fig 128 Patent Blue V 1/5,000



Fig 129 Patent Blue V 1/1,000

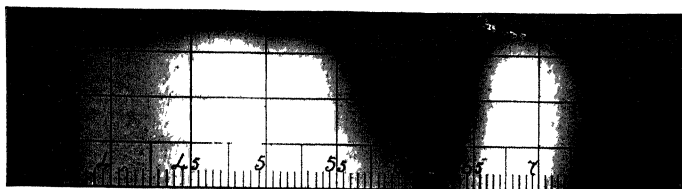


Fig 130 Cyamine Blue 1/10,000

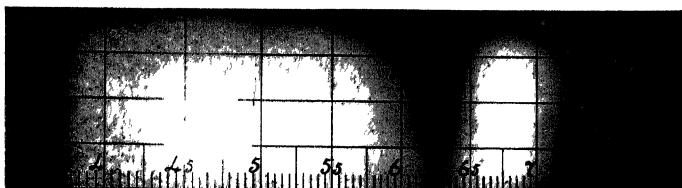


Fig 131 Erioglaucine A 1/10,000

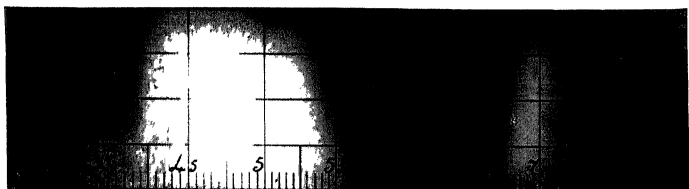


Fig 132 Erioglaucine A 1/1,000



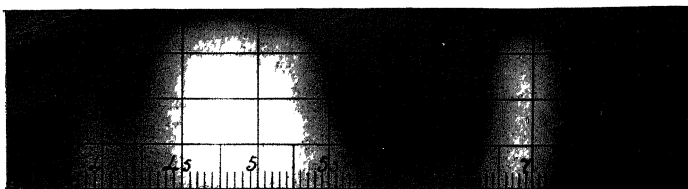


Fig 133 Setoglaucine 1/5,000

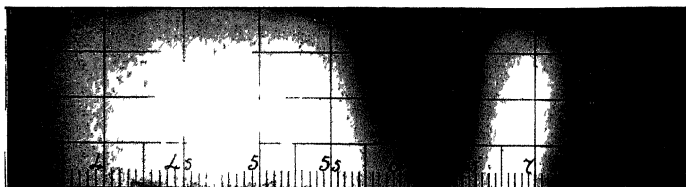


Fig 134 Turkish Blue B B 1/10,000



Fig 135 Turkish Blue B B 1/1,000



Fig 136 Methylene Green 1/5,000

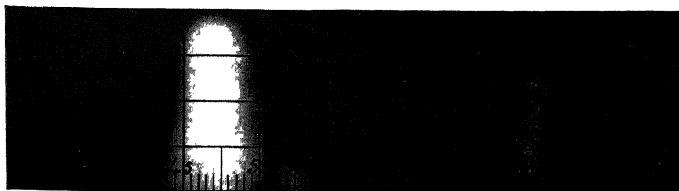


Fig 137 Methylene Green 1/1,000

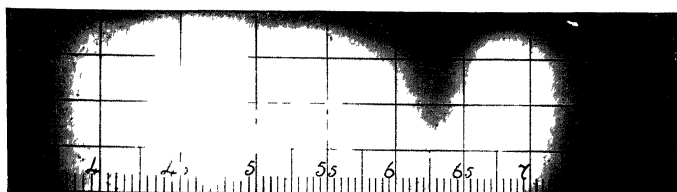


Fig 138 Iodine Green 1/10,000

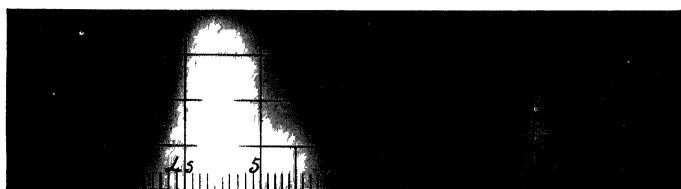


Fig 139 Iodine Green 1/1,000

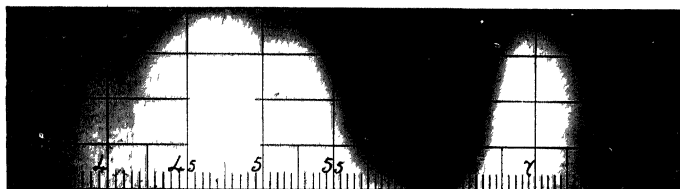


Fig 140 Fast Green Blue Shade 1/1,000

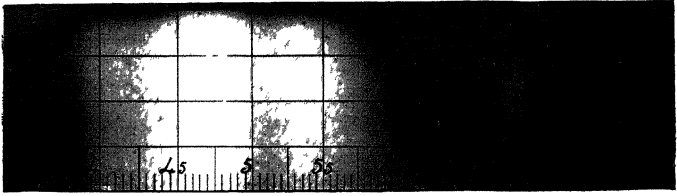


Fig 141 Complementary Green 1 1/10 000

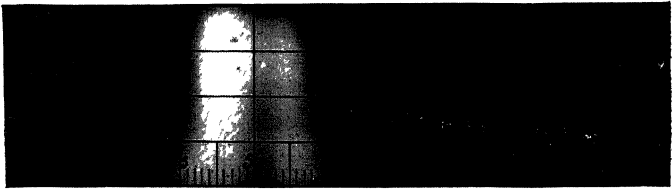


Fig 142 Complementary Green 1 1/1,000

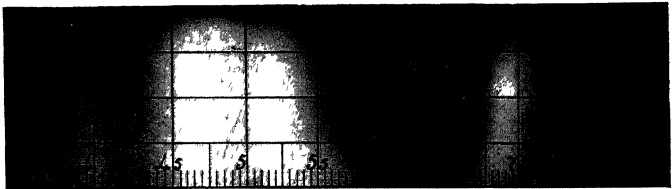


Fig 143 Solid Green 1/1,000



Fig 144 New Solid Green 1/10,000

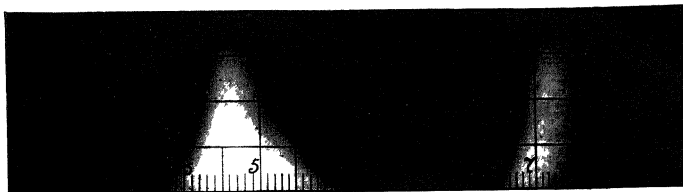


Fig 145 New Solid Green 1/1,000

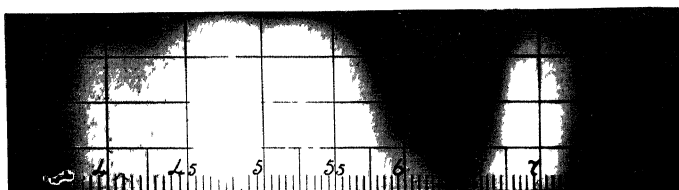


Fig 146 Naphthaline Green 1/10,000

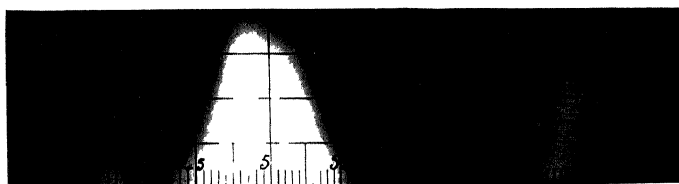


Fig 147 Naphthaline Green 1/1,000

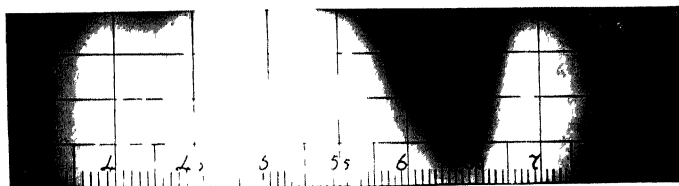


Fig 148 Rapid Filter Green 1/10,000

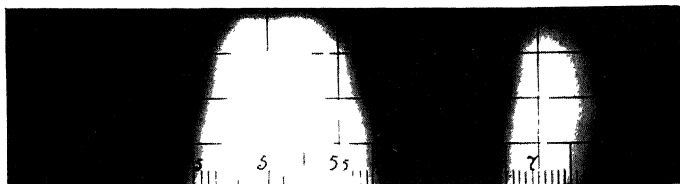


Fig 149 Rapid Filter Green 1/1,000

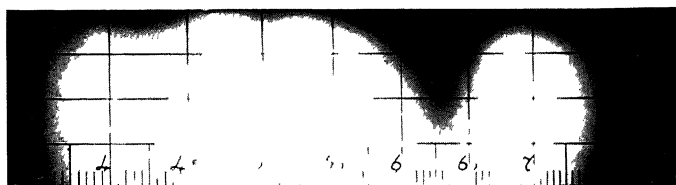


Fig 150 Acid Green 1/5,000

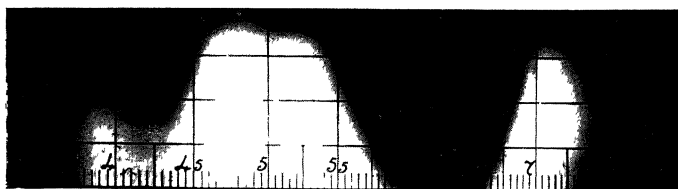


Fig 151 Acid Green 1/1,000

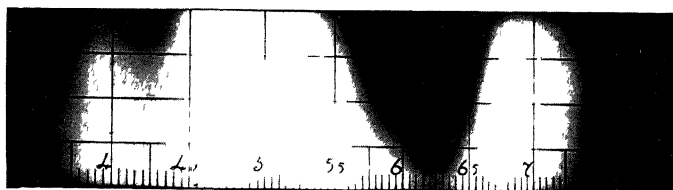


Fig 152 Emerald Green 1/1,000

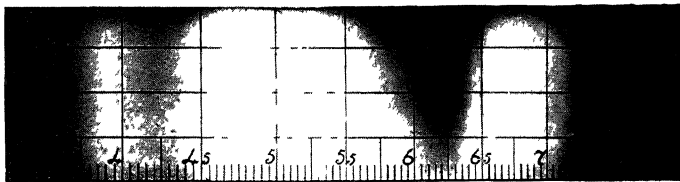


Fig 153 Brilliant Green 1/5,000

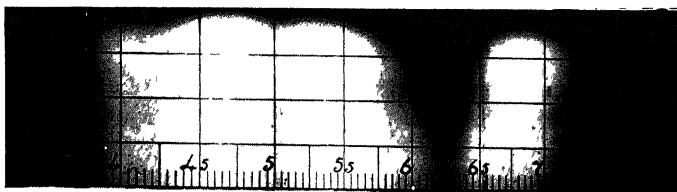


Fig 154 Diamond Green 1/10,000



Fig 155 Diamond Green 1/1,000

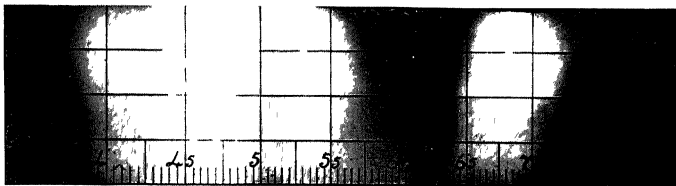


Fig 156 Victoria Green 1/10,000

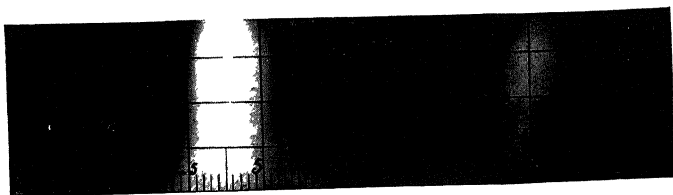


Fig 157 Victoria Green 1 1/1,000

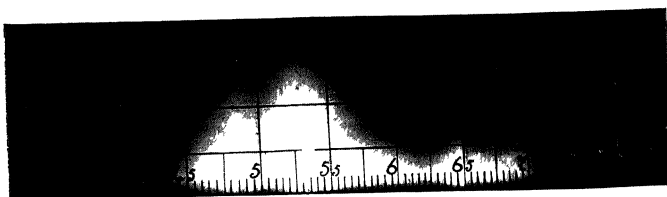


Fig 158 Eboh Green 1/1,000

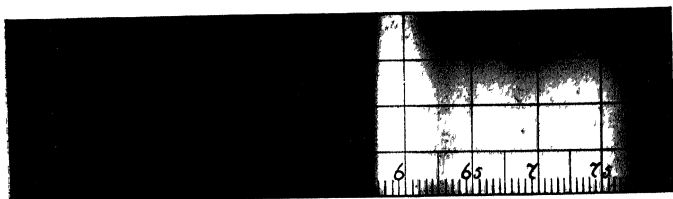


Fig 159 Naphthol Green 1/5,000 (Red end only)

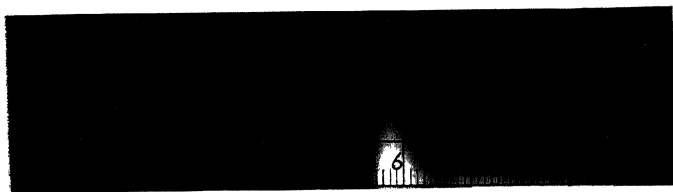


Fig 160 Naphthol Green 1/1 000 (Red end only)

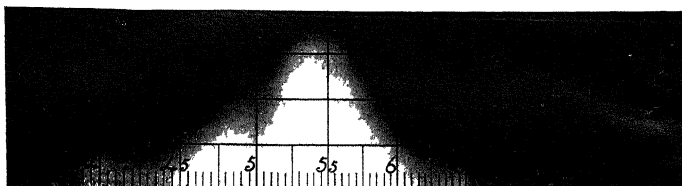


Fig 161 Naphthol Green 1/1,000

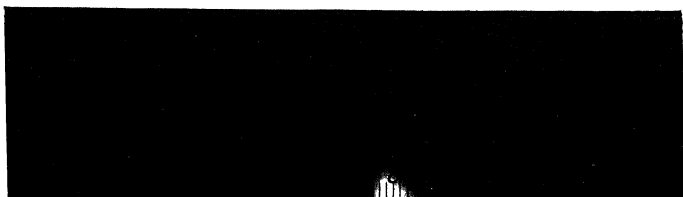


Fig 162 Naphthol Green 26 1/2,500 (Red end only)

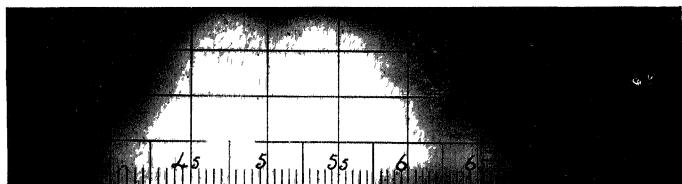


Fig 163 Naphthol Green 26 1/1,000

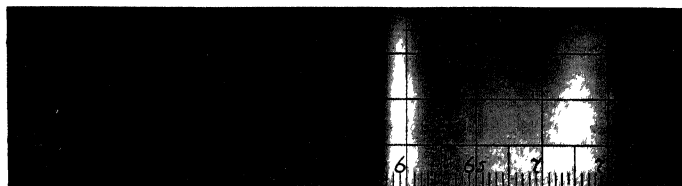


Fig 164 Pmatype Green M 1/5,000 (Red end only)





Fig 165 Pinatype Green M 1/1,000

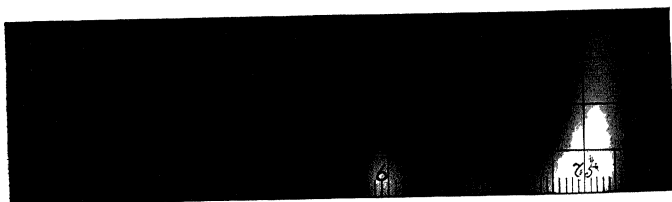


Fig 166 Toluidine Green 1/2,000 (Red end only)

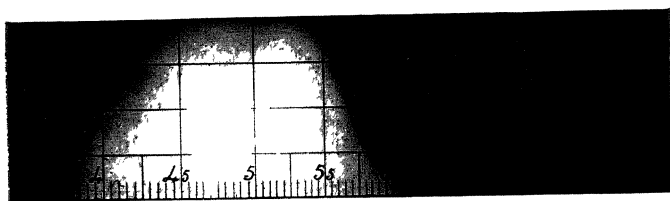


Fig 167 Filter Blue Green 1/1,000

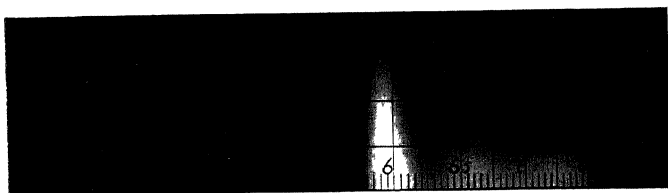


Fig 168 Filter Blue Green 1/500 (Red end only)

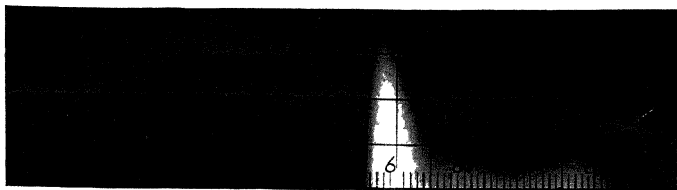


Fig 169 Filter Blue Green 1/20' (Red end only)

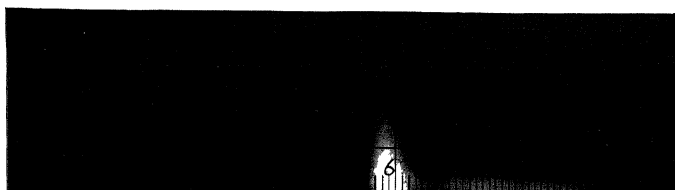


Fig 170 Filter Blue Green 1/100 (Red end only)

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## Filters.

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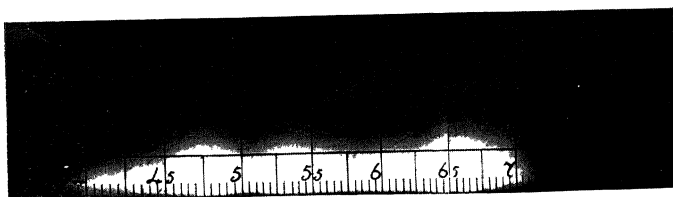


Fig 1  $\beta$  Naphtholdisulphonic Acid

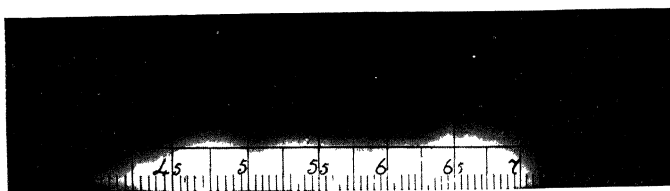


Fig 2 Æsculine

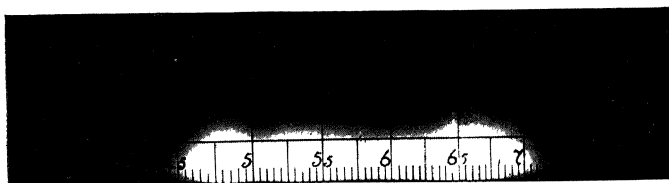


Fig 3 Picric Acid "D"

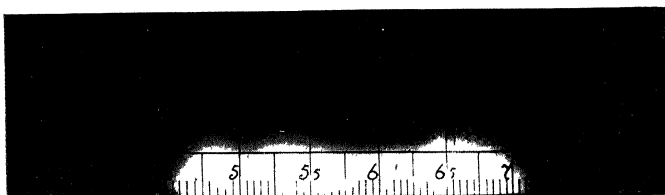


Fig 4 Picric Acid "C"

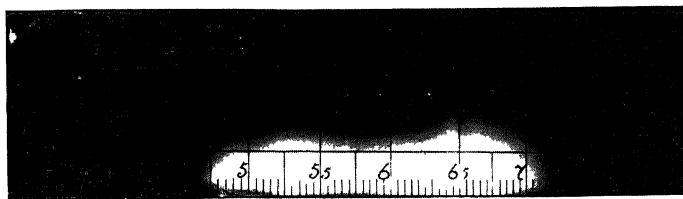


Fig 5 Picric Acid "B"

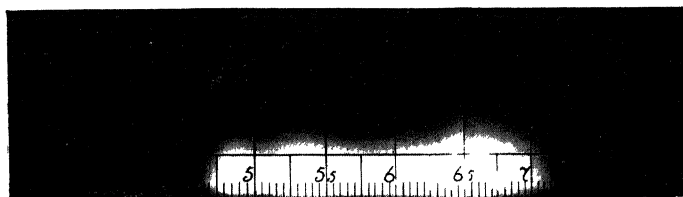


Fig 6 Picric Acid "A"

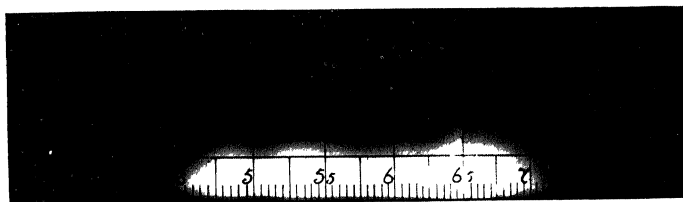


Fig 7 K1

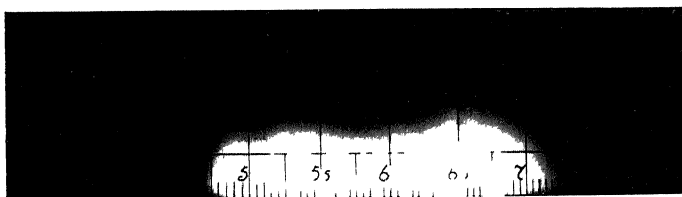


Fig 8 K2

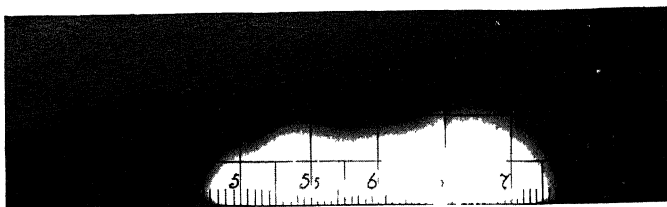


Fig 9 K 3 M

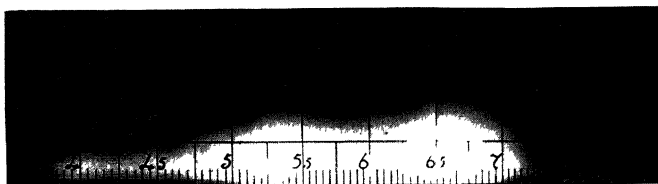


Fig 10 Tartrazine 1

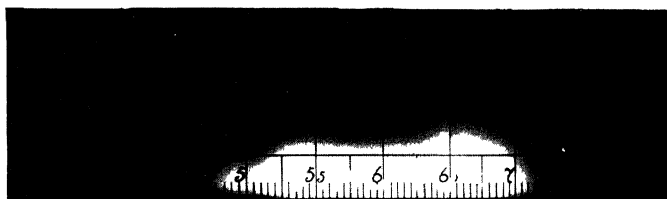


Fig 11 Tartrazine 2

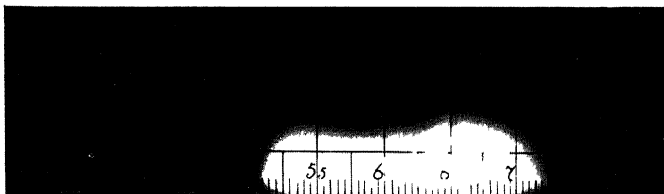


Fig 12 Minus Blue Standard Complementary

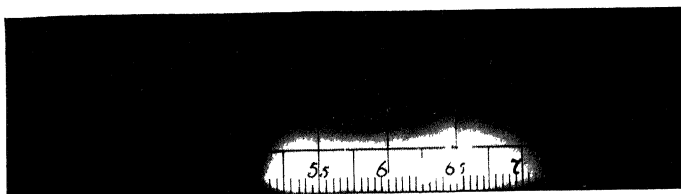


Fig 13 G A 1

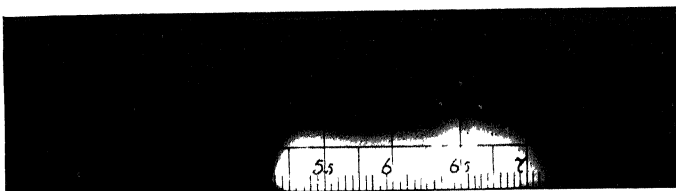


Fig 14 G A 4

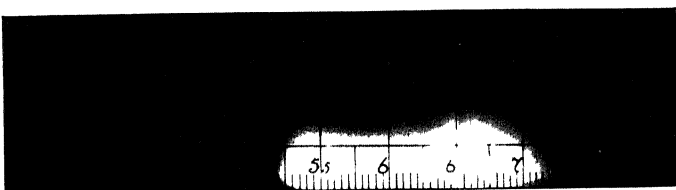


Fig 15 G M

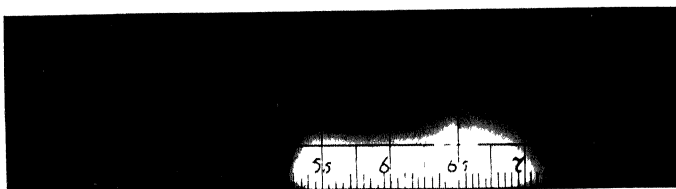


Fig 16 Flavazme T

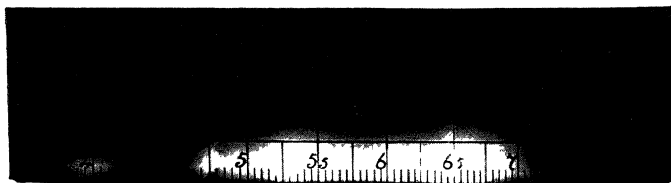


Fig 17 *p* nitrosodimethylamine



Fig 18 Ultraviolet Filter

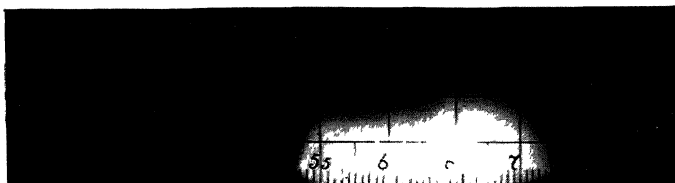


Fig 19 Mandarin Orange

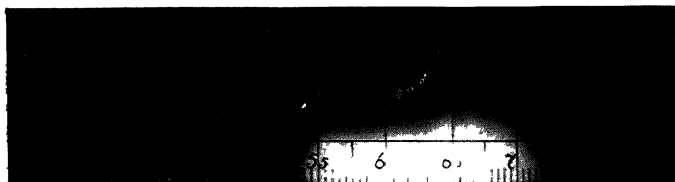


Fig 20 Monobromofluorescein (light)

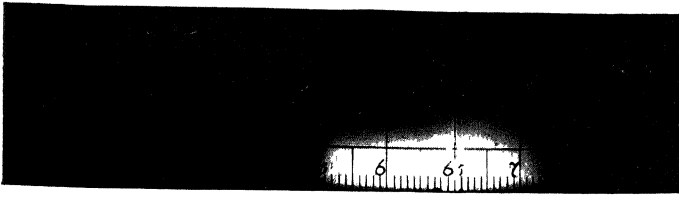


Fig 21 Monobromofluorescence (dark)

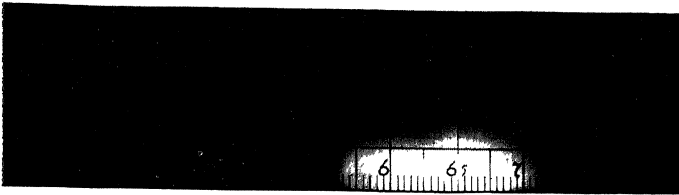


Fig 22 E2 "M "

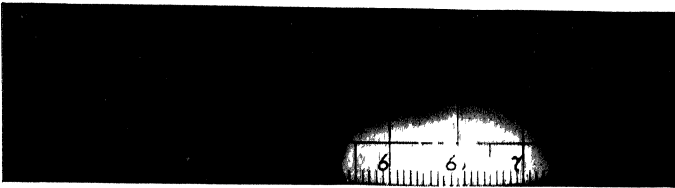


Fig 23 E1

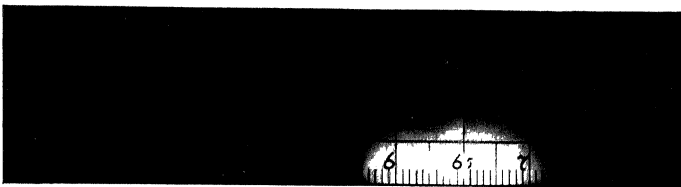


Fig 24 E (red)



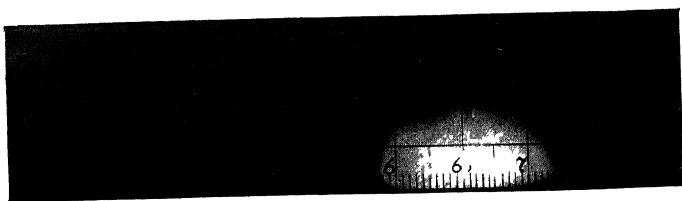


Fig 25 A M Standard Tricolour

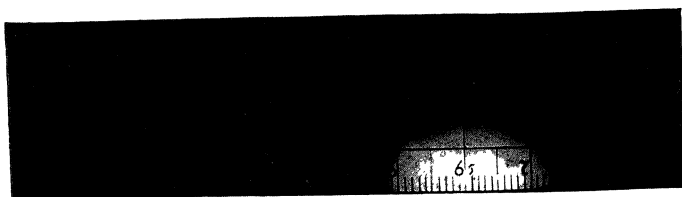


Fig 26 Stereo Red

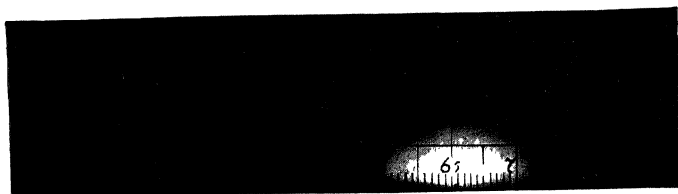


Fig 27 F1

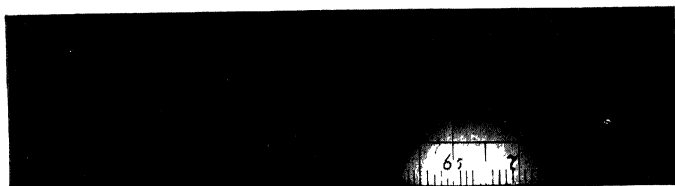


Fig 28 F2



Fig 29 F3 M

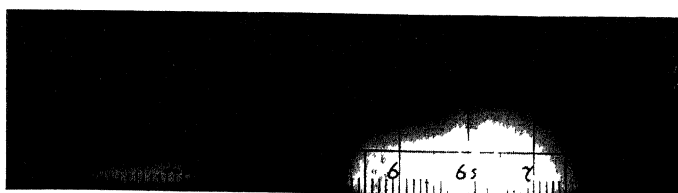


Fig 30 Rose Bengal

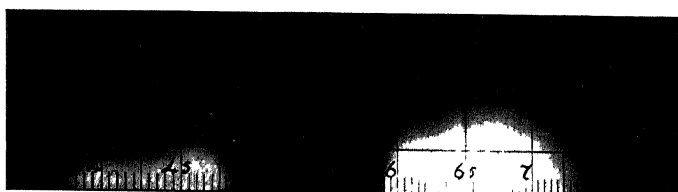


Fig 31 Minus Green 1

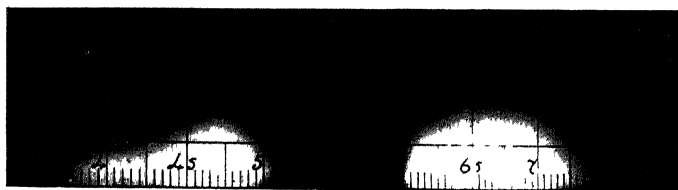


Fig 32 Minus Green 3 Standard Complementary



Fig 33 Xylene Red

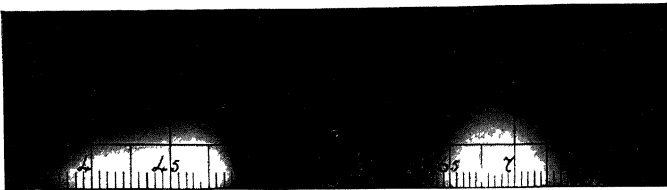


Fig 34 D (light)



Fig 35 D M

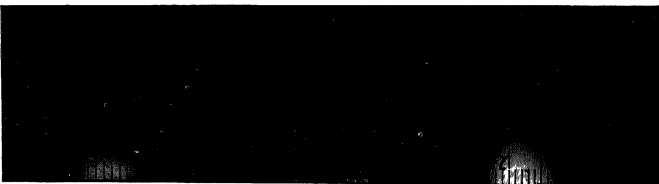


Fig 36 Methyl Violet B B R

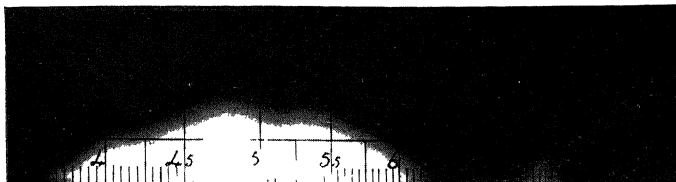
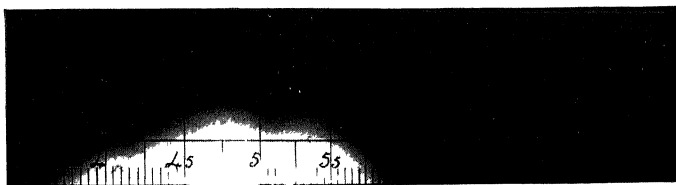
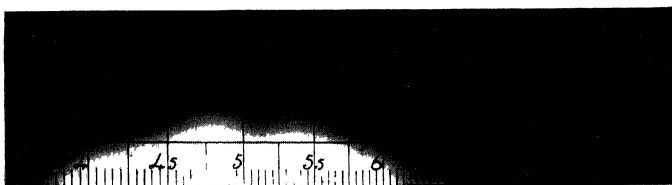
Fig 37  $\beta$  BlueFig 38  $\beta$  Blue (dark)

Fig 39 Blue 203

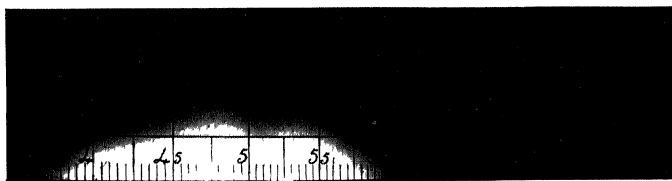


Fig 40 Blue 316

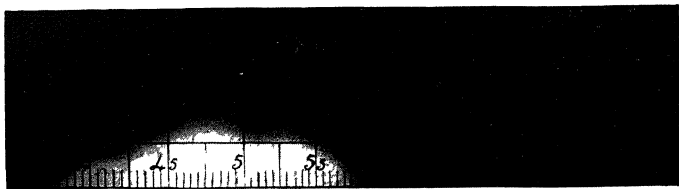


Fig 41 Blue 363

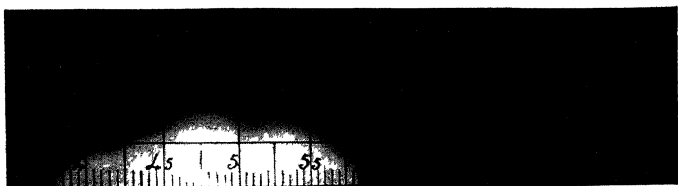


Fig 42 Blue 445

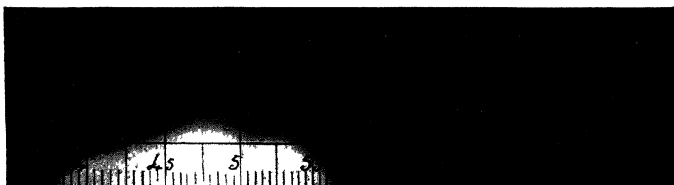


Fig 43 Minus Red 2

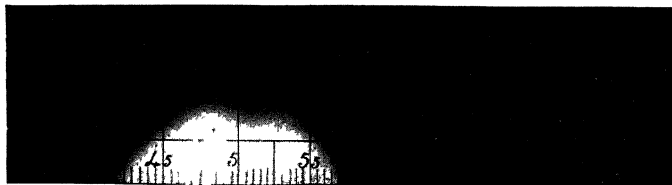


Fig 44 Minus Red 4 Standard Complementary



Fig 45 H M

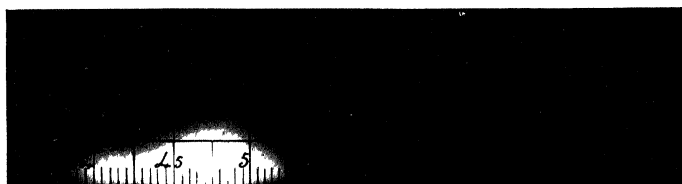
Fig 46  $\eta$  Blue

Fig 47 C (hght)



Fig 48 C1 M Standard Tricolour



Fig 49 C2

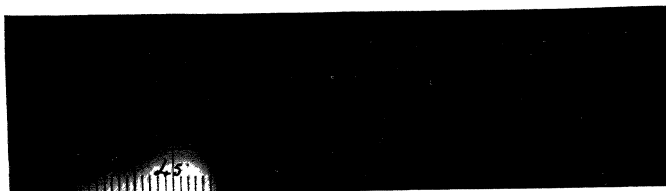


Fig 50 L Mercury Violet Mercury Monochromat

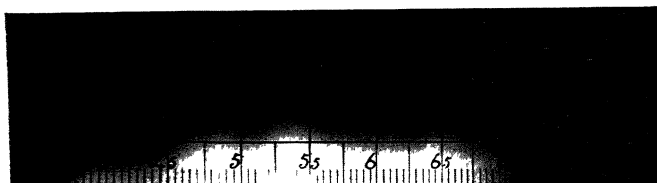


Fig 51 Naphthol Green 1

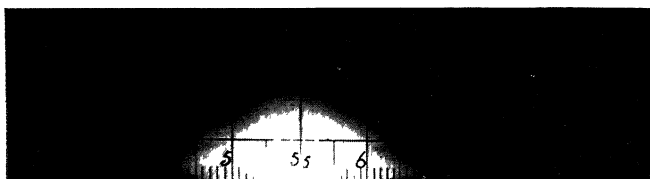


Fig 52 Naphthol Green 2



Fig 53 Naphthol Green 3

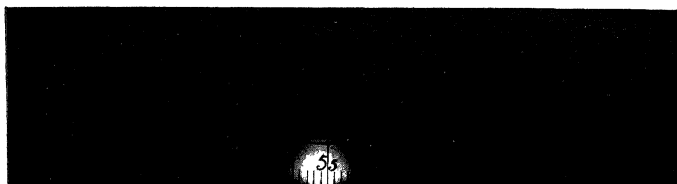


Fig 54 Naphthol Green 4



Fig 55 Stereo Green

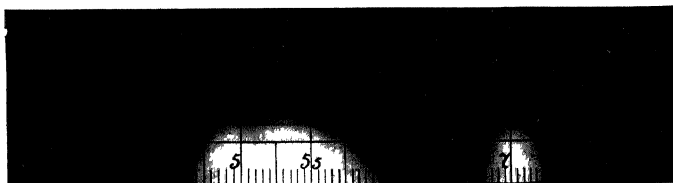


Fig 56 B3



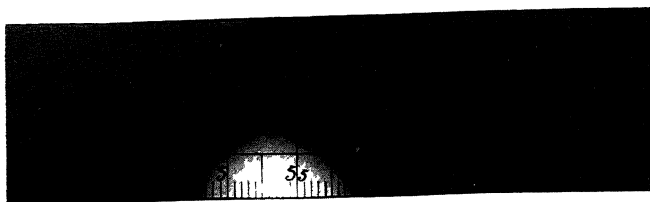


Fig 57 B2 (light)

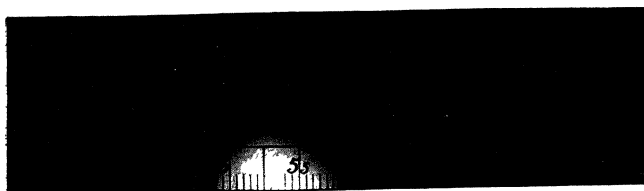


Fig 58 B2

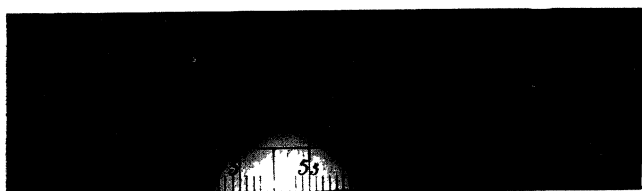


Fig 59 B M Standard Tricolour Green

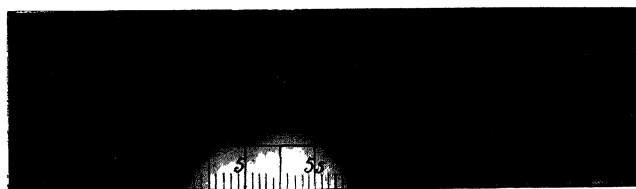


Fig 60 P  $\delta$  Green

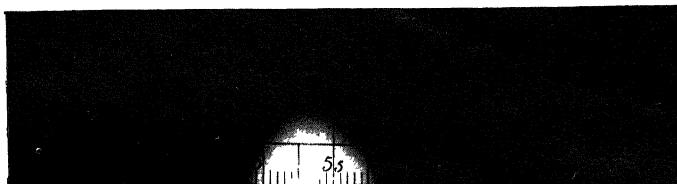


Fig 61 N Additive Green



Fig 62 Mercury Green (Mercury Monochromat)



Fig 63 e Green

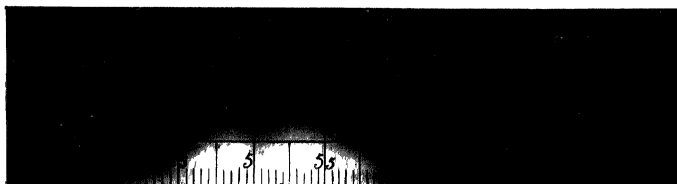


Fig 64 Minus Red 3 (light)

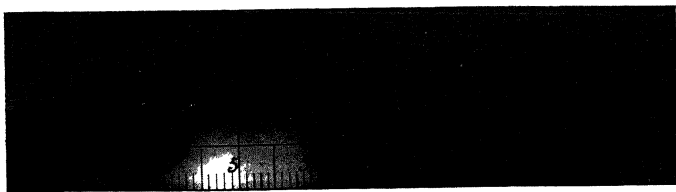


Fig 65 Minus Red 3

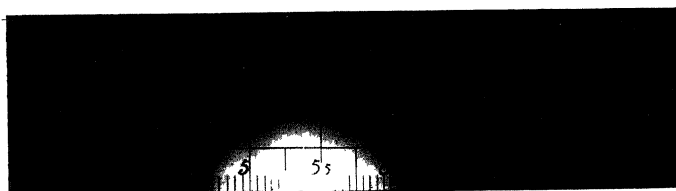
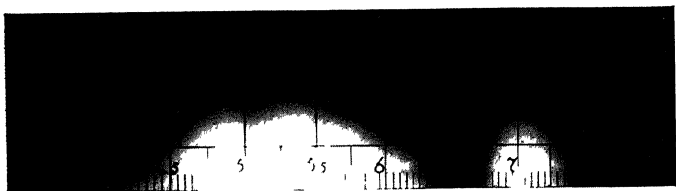
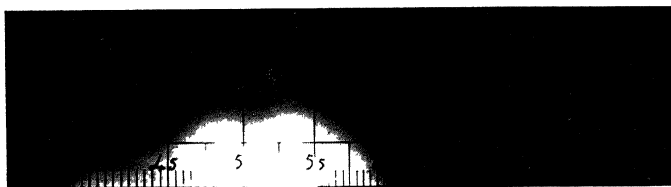
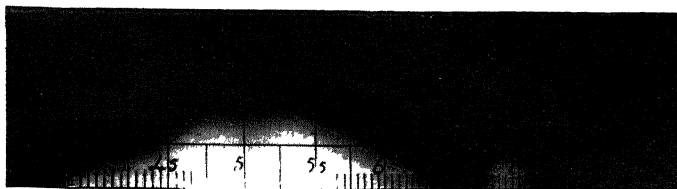
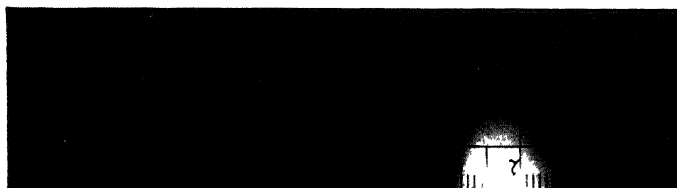
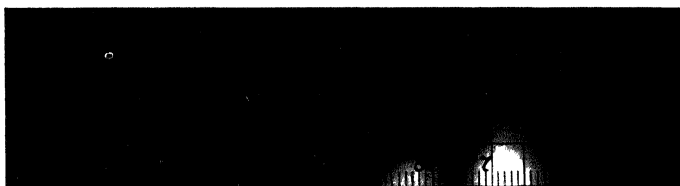
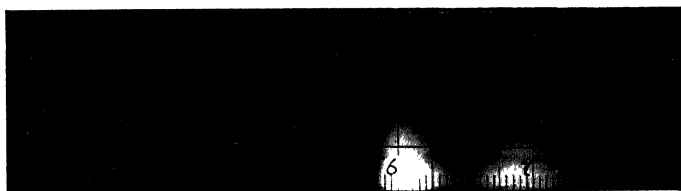
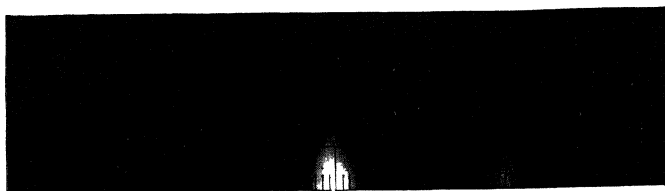
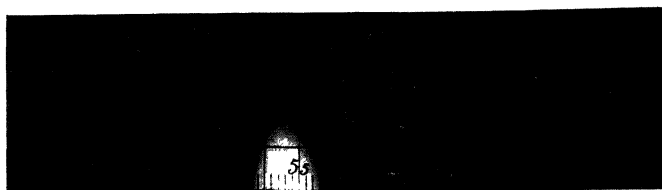
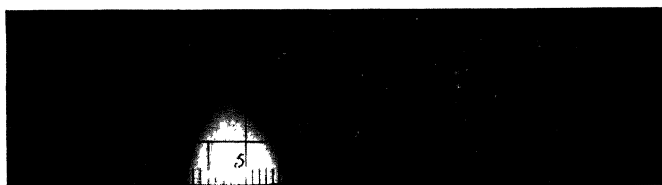


Fig 66 Rapid Filter Green

Fig 67  $\gamma$  Green 2Fig 68  $\gamma$  Green 3

Fig 69  $\gamma$  (Heen 4)Fig 70  $\alpha$  (Monochromat)Fig 71  $\beta$  (Monochromat)Fig 72  $\gamma$  (Monochromat)

Fig 73  $\delta$  (Monochromat)Fig 74  $\epsilon$  (Monochromat)Fig 75  $\eta$  (Monochromat)Fig 76  $\theta$  (Monochromat)

